An empirical investigation into the uptake, motivations and constraints and the factors affecting farmers' renewable energy investment intentions

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Abstract

The rate of adoption of renewable energy (RE) production and associated enterprises on-farms in the UK has been lower than expected suggesting that the UK government's energy, agricultural and climate change objectives may not be achieved. The aim of this research is to investigate why this is the case by assessing the uptake, motivations, constraints and the factors affecting farmers' RE investment intentions. Building on extant research literature (institutional theory, social cognition theory, theory of planned behaviour and the resource based view) a novel comprehensive and multidimensional model of entrepreneurial intentions was developed and tested using principal component, path and multivariate regression analysis techniques.

Data were collected to test the model through a sample of 2000 farmers in the West Midlands Region of the UK. Of the 393 farmers who responded, 14% adopted RE enterprises, with half of adopters reporting slight to significant improvements in farm business performance in 2009. Solar panels were the most popular of the RE technologies available to farmers, compared to biomass related technologies. The study found that the most influential personal level factors contributing to the adoption of RE and associated technologies were cognitive such as the level of education. Of current 338 non-adopters, 66% might decide to invest in RE technologies over the next five years. For these potential adopters, the study shows that the type of tenure, educational attainment and the type of farm business diversification activity in which a farmer is engaged are the most significant personal and farm business situational factors which influence farmers' RE investment intentions though contrary to expectation current non-adopters assessed the policy support framework more favourably than current adopters. The explanation of this seems to be connected with timing, in that two very positive and encouraging signals in relation to

Feed in Tariffs (2010) and the Renewable Heat Incentive (2011) were underway or near introduction before this research took place.

The study provides the first empirical evidence of the effects of the multidimensional measures of the country's institutional profile on farmers' RE investment intentions. Secondly, it clarifies the distinct role played by national formal and informal institutions on farmers' investment intentions showing that informal institutions and not formal regulatory factors have a direct effect on farmers' intentions to invest in RE enterprises. Thirdly, the investigation reveals that social acceptability of entrepreneurship in the RE sector is negatively related to investment intentions and moderates the efficacy of formal government policies in influencing entrepreneurial behaviour in the RE sector. The study concludes that any study that relies only on one type of institution will be making significant prediction mistakes.

This study provides further support for cognitive based process models of intentions by showing strong significant positive effects of perceived self-efficacy and perceived desirability of RE enterprises on investment intentions. In fact, the study shows that farmers' attitudes towards RE explain the highest amount of variance in investment intentions over and above the combined effect of external resource and institutional factors. The study illustrates that perceived self-efficacy and perceived desirability of RE enterprises mediate the effect of the rich set of exogenous variables investigated in this study on investment intentions and argues that policy makers need to focus on improving the regulatory, cognitive and normative institutional environments as a way to improve attitudes towards RE and consequently their intentions to invest in these enterprises.

Research outputs

1. **Mbzibain, A**. (2012) The effect of farmer capacities, farm business resources and perceived support of family, friends and associational networks on intentions to invest in renewable energy ventures in the UK. *International Journal of Applied Behavioural Economics (forthcoming, 3rd issue 2013).*
2. **Mbzibain, A**., Hocking, T., Tate, G. and Ali, S. (fortcoming) Renewable energy enterprises on UK farms: Assessing levels of uptake, motivations and constraiints to widespread adoption. *Biomass and Bioenergy*, xxx (2012) pp.1-10. http://dx.doi.org/10.1016/j.biombioe.2012.11.028.
3. Tate, G., **Mbzibain, A.** and Ali, S. (2012) A comparison of the drivers influencing farmers' adoption of enterprises associated with renewable energy. *Energy Policy*, **49**(1) 400-409
4. Tate, G. and **Mbzibain, A.** (2011) The future contribution of bioenergy enterprises to rural business viability in the United Kingdom. *International Journal of Agricultural Management*, **1**(2), pp.23-37.
5. **Mbzibain, A,** Hocking, T.J, Tate, G and Ali, S (2011) Biomass enterprises on UK farms: Factors influencing renewable energy investment decisions by farmers. *Aspects of Applied Biology* 112, 2011
6. **Mbzibain, A,** Tate, G and Ali, S (2012) The impact of national institutional structures on farmers' intentions to invest in renewable energy enterprises in the UK. Paper submitted for publication in the *Journal of Small Business and Enterprise Development*. Under Review
7. **Mbzibain, A,** Tate, G, Hocking, T.J, and Ali, S (2011) The impact of social norms, networks, regulatory and cognitive factors on environmental entrepreneurship: The case of the UK farm sector. Paper presented at the ISBE Conference 2011 held at Sheffield University, November 09-10, 2011

8. **Mbzibain, A** and Tate, G (2011) Exploring factors affecting farmers' decisions to invest in RE on UK farms. Paper presented at the 9th Rural Enterprise Conference held at Nottingham Trent University, September 22-23, 2011
9. **Mbzibain, A** (2011) Renewable energy enterprises: a viable business proposition for the UK Farm Sector? Won the University of Wolverhampton post graduate poster competition, September 2011
10. **Mbzibain, A** (2011) Renewable energy enterprises: a viable business proposition for the UK Farm Sector? Paper presented at the 19th European Biomass conference held in Berlin in June 2011

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List of abbreviations

AD	Anaerobic digestion
ANOVA	Analysis of Variance
CAP	Common Agricultural Policy of the EU
CO_2	Carbon dioxide
DECC	Department for Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DFT	Department for Transport
EC	European Commission
EU	European Union
FBS	Farm Business Survey
FITs	Feed in Tariffs
GDP	Gross Domestic Product
GHG	Green House Gas
Ha	Hectare
IFPRI	International Food Policy Research Institute
KMO	Kaiser-Meyer-Olkin measure
KW	Kilowatt
MWh	Megawatt hour
NFU	National Farmers' Union
NFFO	Non-Fossil Fuels Obligation
Ofgem	Office for Gas and Energy Markets
PCA	Principal Component Analysis
UNFCC	United Nations Framework Convention on Climate Change
RE	Renewable Energy
RES	Renewable Energy Sources
RHI	Renewable Heat Incentive
TPA	Theory of Planned Action
TPB	Theory of Planned Behaviour
TWh	Tera Watt Hour
RO	Renewables Obligation
ROCs	Renewable Obligations Certificates

RTFO	Renewable Transport Fuel Obligations
SCT	Social Cognition Theory
SEE	Shapero Entrepreneurial Event
SRC	Short Rotation Coppice
UNEP	United Nations Environmental Programme
UN	United Nations
UK	United Kingdom

Kilowatt hour (kWh): A unit of energy, equal to the total energy consumed at a rate of 1,000 watts for one hour. The kilowatt hour is equal to 3.6 million joules.

1,000 kWh = Megawatt hour (MWh)

1,000 MWh = Gigawatt hour (GWh)

1,000 GWh = Terawatt hour (TWh)

Mega hectare (Mha): A hectare is a unit of surface, or land, measure equal to 100 acres ($100m^2$), or 10,000 square meters: equivalent to 2.471 acres. A mega hectare is one million hectares.

Megawatt electrical (MWe): The megawatt is equal to one million (10^6) watts. Megawatt electrical is a term that refers to electric power, while megawatt thermal or thermal megawatt refers to thermal power produced.

Chapter 1: Introduction

1. Background to the research

The United Nations Population Fund's (UNFPA) State of the World Population 2011 report shows that the global population reached 7 billion people in October 2011. The global population is projected to reach 9 billion by 2050 (UNFPA, 2011). Will there be sufficient land, water, energy and biological resources, to provide adequate food and other essential human needs? (Pimentel and Pimentel, 2006). The International Food Policy Research Institute (IFPRI) argues that the accelerating pace of climate change will make it more difficult to produce enough food to feed the growing population thereby threatening global food security (IFPRI, 2009). The problems will result from water scarcities, droughts, floods, glacial meltdowns for irrigated agriculture, storms, pests and diseases (UNFPA, 2011, Pimentel and Pimentel, 2006). Given these concerns, Olesen and Bindi (2002) suggest that policy makers need to be concerned with agricultural strategies to mitigate climate change through a reduction in emissions, an increase in carbon sequestration in agricultural soils and diversification into land based renewable energy (RE) sources to substitute fossil energy. RE refers to a source of energy that has the power to replenish itself e.g. solar, wind, biomass energy.

Climate change is the result of natural phenomena and human action but the Intergovernmental Panel on Climate Change (IPCC) has argued that anthropogenic influence accounts for greater part of the problem and poses a threat to the sustainability of our planet (IPCC, 2007). The stock of greenhouse gases - Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxides (N_xO), Hydroflourocarbons (HFCs), Perflourocarbons (PFCs) and Sulphurhexaflourides (SF_6) in the atmosphere is responsible for keeping the earth warm

but disproportionate increase of these gases in the atmosphere causes global warming, resulting to climate change. The Stern report on the economics of climate change warns that such an increase is likely to lead to catastrophic results for mankind and recommends rapid policy action to arrest the situation (Stern, 2008). According to Stern, it would require 1% of global Gross Domestic Product (GDP) with good policy and timely decision making to stabilise global CO_2 equivalents (eq) at 550 parts per million (ppm), warning that the costs of delay are likely to be 3 to 4 times higher. The CO_2 eq is an international approach to compare the effects of other greenhouse gases to global warming compared to the lead gas CO_2. The value is obtained by multiplying the relative greenhouse potential of a gas by its mass to obtain the quantity of CO_2 which will develop the same greenhouse effect over an observation period of 100 years (IPCC, 2007). Figure 1.1 below highlights the evolution of GHG emissions since 1970 to 2004 (a). It also shows the composition by type of GHG in 2004 (b) as well as the sources in 2004 (c).

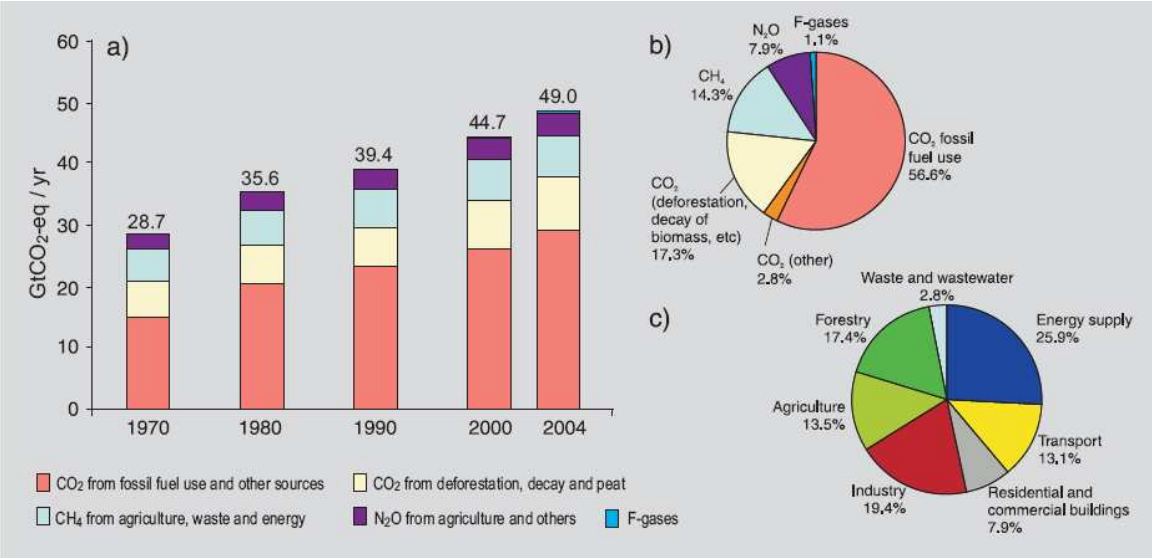


Figure 1.1: Global anthropogenic GHG emissions
Source: IPCC (2007)

In order to slow down the effects of climate change, leaders of industrialised/developed countries within the United Nations Framework Convention on Climate Change (UNFCC) agreed to a legally non-binding target to reduce their GHGS emissions to 1990 levels by

2000 – the so called Kyoto protocol in 1997. The protocol enjoined countries (so called Annex 1 countries) to implement or elaborate policies to reduce GHG emissions, protect and enhance carbon sinks and reservoirs of GHGs, promote sustainable agriculture and importantly invest in research and development of renewable forms of energy (IPCC, 2007).

The protocol also laid binding targets for anthropogenic CO_2 emissions (with the aim to reduce GHG emissions to 5% below 1990 levels during 2008-2012) by the signatories. While legally binding engagements between nations are still far off, there seems to be global agreement on the fact that the use of clean energy sources, especially RE, is a clever way to move towards a low carbon world, reduce dependence on the finite fossil fuel resources (which are mainly responsible for CO_2 emissions), and mitigate the effects of climate change (German Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2009). The transition to a low carbon economy is challenging at this particular time characterised by the economic downturn. Under economic conditions characterised by a downshift, potential investors are quite nervous about the stability of government policies to climate change targets (Masini and Menichetti, 2012, Wüstenhagen and Menichetti, 2012).

According to IFPRI (2006), RE production is subject of increasing attention around the world at a time when oil prices are reaching unprecedented levels and concerns about the environmental hazards of fossil fuel use are on the rise. It is fair to mention that recent threats by the Iranian military to block the Strait of Hormuz are further signs that dependence on fossil fuels also has international/national security implications (Talmadge, 2008). RE is considered as a clean source of energy which can help countries cope with the increasing oil prices, address concerns about greenhouse gas emissions, climate change mitigation, and energy security and also improve on the living conditions of farmers

around the world (Demirbas *et al.* 2009). For these reasons, many energy importing countries, which are looking at options to diversify their energy sources, are turning to RE as an attractive prospect (Junginger *et al.* 2008).

1.1. The problem

Due to declines in traditional agricultural support in the European Union (EU), production and income alternatives for farmers seem necessary (Meert *et al.* 2005, Tranter *et al.* 2007, Ilbery *et al.* 2009, McElwee and Bosworth, 2010, Vik and McElwee, 2011). According to Domac *et al (*2005a) and Domac *et al* (2005b), RE production is one of the diversification options available to farmers. The UK government is looking to rural entrepreneurs to contribute towards achieving the country's energy and climate change targets through the adoption of RE enterprises (DECC, 2010a, DECC, 2010b). The RE roadmap admits that timely investments are needed to ensure that RE contributes towards shielding the country from fossil fuel price fluctuations and reaching the target of 15% of energy consumption from renewable sources by 2020 and 80% reduction in GHGs emissions by 2050 (DECC, 2011b). Figure 1.2 below shows the projected increase in energy from renewable sources to meet 15% energy targets.

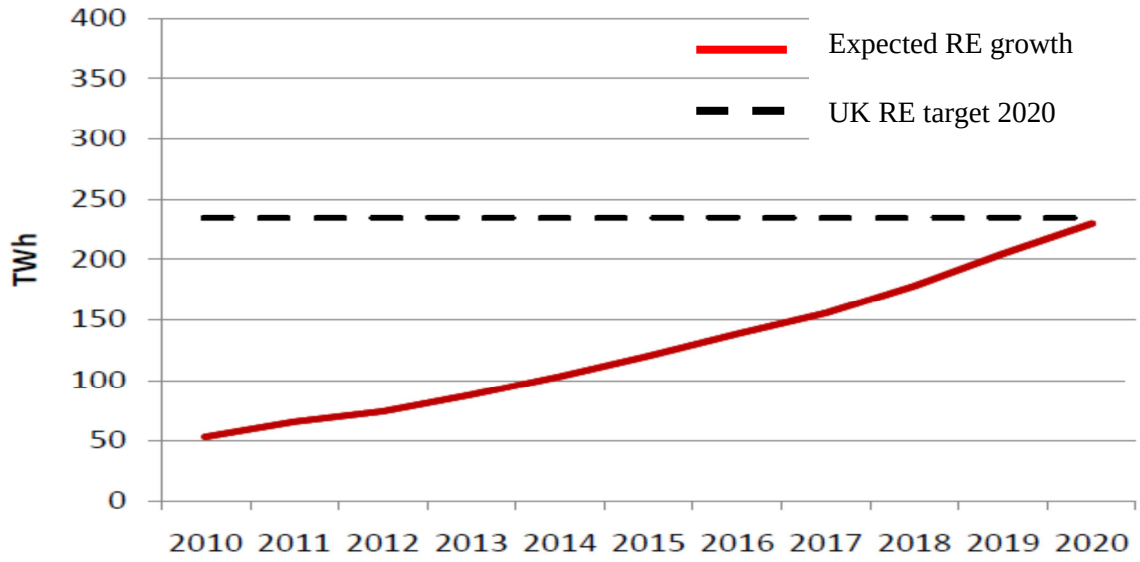


Figure 1.2: Central view of renewable energy deployment and the 15% target
Source: DECC (2011b, p. 17)

Taking biomass production for energy production as an example, the Department for Transport (DFT) estimates that bioenergy could contribute up to 8-11% of UK energy demand by 2050 (DFT, 2009). The latest estimates from the UK Government's Biomass Strategy suggest that it will require the cultivation of between 9 300 Km^2 to 36 300 Km^2 of energy crops in England and Wales to reach the expected contribution from bioenergy production up from about 10 000 Km^2 in 2011 (DECC/DFT/DEFRA, 2012). In 2010, just under 5% of farms in England used renewable sources to produce energy (DEFRA, 2012). To reach the targets for bioenergy requires a yearly increase of 20% in the surface areas planted which would correspond to between 6% and 24% of the total land area in England and Wales or 9% to 35% of land currently under some form of agricultural production. This is only possible if farmers' adoption of energy crop production were to increase significantly, it is argued (DECC/DFT/DEFRA, 2012). Thornley and Cooper (2008) argue that the UK is likely to miss its 15% target of energy from RE sources by a long way considering that this stood at 3.3% in 2010 (DECCA/DFT/DEFRA, 2012).

Some of the land for bioenergy production is expected to come from land set-aside since the set aside scheme of the Common Agricultural Policy (CAP) of the EU encourages production of energy crops under its two pillars of support to farmers and rural areas (Rowe *et al.* 2009). Investment in RE enterprises has been promoted as an integral part of the strategy to achieve the aims of the CAP through a series of Rural Development Programme initiatives (Natural England, 2011, Nix, 2012, Natural England, 2009).

Clearly, the contribution of farmers and the wider community is important to ensure that government RE targets are attained but their role has not been sufficiently addressed by research (Mattison and Norris, 2007, Sherrington *et al.* 2008, Tranter *et al.* 2011, Tate and Mbzibain, 2011). Research is required to understand farmers' behaviours because their

acceptance of RE production could be an important constraint for realising widespread uptake (Clancy *et al.* 2012, DECC/DFT/DEFRA, 2012).

There are undoubtedly a number of factors why the deployment of RE in the UK is not happening as quickly as it might be expected compared with other EU neighbours with similar RE resources (German Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2009, Slade *et al.* 2009, Thornley and Cooper, 2008, Plieninger, 2006). A key line of inquiry into the factors affecting RE adoption has been on the effects of government RE policy. This is because RE is still in its early stages of development and up to now has been driven mainly by government policy. The result of this type of research has been mixed however. While some scholars view the policy framework in support of RE in the UK as being largely comprehensive (Slade *et al.* 2009) others differ on the grounds that the framework is insufficient to make the deployment of RE viable while supplementary support mechanisms are fragmented, regionally dispersed, complicated and have been subject to frequent changes thus creating a very unstable and risky environment for potential adopters (Thornley, 2006, Thornley and Cooper, 2008, Thornley *et al.* 2009, Howard *et al.* 2009).

It is increasingly recognised that the main barrier behind the low uptake of RE enterprises in the EU and the UK more specifically has not been the lack of capital, but the lack of adequate institutional packages to make it attractive especially the inability of these packages to leverage the true drivers of the investment decision making process (Thornley and Cooper, 2008, Convery *et al.* 2012, Rogers *et al.* 2008, Masini and Menichetti, 2012). It is argued that research into the evaluation of policy effectiveness has often failed to tackle the issues of the role of institutions satisfactorily (Minniti, 2008). Much of the research on the impact of national policies often takes a limited view and tends to focus on a restricted number of factors especially taxes, loans, subsidies (Busenitz *et al.* 2000,

Kostava 1997, Manolova *et al.* 2008, DECC/DFT/DEFRA, 2012). For this reason, the much broader understanding of the role of institutions in new venture creation decision making processes is lacking in extant research (Szyliowicz and Galvin, 2010). It is also argued that such studies especially those focused on RE policy provide very limited insights into the investor's perspectives, while other types of external factors, including informal institutions, are given very little attention. The lack of emphasis on the investor's perspective is an important shortcoming in extant research (Huijts *et al.* 2012, Masini and Menichetti, 2012, Wüstenhagen and Menichetti, 2012).

> 'In a market economy, the effectiveness of policies aimed at mobilizing RE investments is critically dependent upon their impact on investors' behaviours. To maximize the impact of future policies, policy makers need to get a better understanding of how investors behave, and of how they take their decisions, particularly in regards to the key psychological factors that may influence their behaviours and actions. There is a surprising lack of rigorous empirical studies examining these issues in the energy policy literature' (Masini and Menichetti, 2012 pp. 36-37).

Similar calls to integrate psychological factors affecting investment decision making processes in agriculture have been made by Tranter *et al* (2007). These scholars propose that one way to obtain insight into the response of investors (*farmers in this case*) to institutional impacts is to carefully undertake a survey of their future intentions (Thompson and Tansey, 1982, Tranter *et al.* 2007).

The ability of farmers to start new activities on farms has been an important area of research within agricultural research (Carter, 1998, Carter, 2001, Chang and Boisvert, 2009, Damianos and Skuras, 1996, Davis *et al.* 1997, Alsos *et al.* 2003, Vesala *et al.* 2007). One major motivation for studies in this area has been to provide understanding of the reasons why farmers start new enterprises in general or why they switch to new enterprises (Vik and McElwee, 2011). According to Windle and Rolfe (2005) this type of research is important if policy makers wish to predict the speed of restructuring in industries that have been affected by external or internal pressures. Secondly, such

information is necessary to assist policy makers to develop packages to support the restructuring processes and may also assist in the reallocation of resources to support new venture creation processes or to help mitigate negative impacts. Jones (2006) argues that understanding why farmers start new enterprises is relevant if predictions need to be made about the rate of take up (or not) of some technologies (*RE production enterprises my emphasis*).

Despite the widely acknowledged important role of agriculture to economic development, it has often been marginalised in small business research. Small business research has little knowledge about the sector or of the individuals who own farm businesses as farmers have rarely been an empirical setting for entrepreneurship research (Carter, 1998, Carter, 2001). Other researchers have noted the paucity of knowledge with regards to what triggers entrepreneurialism on farms (Alsos *et al.* 2003) and this offers a particularly interesting opportunity for entrepreneurship research (McElwee, 2006). While there is limited knowledge about what triggers entrepreneurship on farms, there is limited knowledge of individuals who own RE enterprises, what triggered/triggers farmers to adopt and what contribution to business performance RE makes to their farms.

It is very likely that the imminent review of the Common Agricultural Policy of the EU (CAP) will continue to emphasise the important role of farm entrepreneurship in increasing the value of agricultural production to the provision of social welfare services such as rural sustainable development, environmental protection, climate change mitigation and adaption (Covery *et al.* 2012, Vik and McElwee, 2011). The resurgence of interest in entrepreneurship by policy makers can be traced to the benefits that are widely believed to be associated with it (Clark, 2009). These benefits include contribution to economic growth, progress, job creation and innovation (Kent, 1984, Reynolds *et al.* 1996). The role of entrepreneurship in contributing to these goals has been subject of widespread academic

research (few examples include Kizner, 1984, Bull and Willard, 1993, Shane and Venkataraman, 2000). Dean and McMullen (2007) argue that entrepreneurship can also play a significant role in addressing concerns of environmental degradation and climate change through the exploitation of opportunities that are created by relevant market failures (e.g. externalities, information asymmetries, failure of government intervention etc.). Despite the potentially important role of entrepreneurship in the environmental realm, the subject has attracted very little attention from entrepreneurship researchers. This view is echoed by Hall *et al* (2010) as they point out that:

> 'there remains considerable uncertainty regarding the nature of entrepreneurship's role in the area, and the academic discourse on sustainable development within the mainstream entrepreneurship literature has to date been sparse' p 439.

1.2. Aims of the research

The aims of this study were:

i) To investigate the level of deployment of RE on UK farms;

ii) To investigate the extent to which RE enterprises contribute to farm business performance;

iii) To assess the types of RE ventures available to farmers;

iv) To assess the motivations for adoption and the constraints which hinder greater adoption of RE enterprises on UK farms; and

v) To determine the factors which influence future behaviour regarding farmers' intentions to invest in RE production and associated enterprises.

1.3. Research questions

Following the statement of the research aims, a number of research questions were proposed.

i) Why is there such a low level of uptake of RE enterprises on UK farms?

ii) To what extent can RE enterprises contribute to farm business performance?

iii) What types of RE enterprises are accessible to farmers?

iv) What are the motivations and barriers to the creation of RE enterprises on farms?

v) Why do some farmers invest in RE enterprises and others do not?

1.4. Theoretical foundations of the study

A review of past RE policy research provided the framework to achieve the first four aims of the study. A thorough exploration of the literature led to the development of a comprehensive theoretical framework and hypotheses to examine the factors affecting investment intentions in order to achieve the fifth aim of the study. This model drew inspiration from the Resource Based View (RBV) (Alsos *et al.* 2003, Alsos and Carter, 2006, Wernerfelt, 1984, Wernerfelt, 1995), the Theory of Planned Behaviour (TPB) (Fishbein and Azjen, 1973, Azjen, 1991), Shapero's Entrepreneurial Event model (SEE) (Shapero and Sokol, 1982, Krueger, 1993), entrepreneurial intentions models (Krueger and Brazeal, 1994, Krueger *et al.,* 2000), Social Cognition Theory (SCT) (Bandura, 1977, 1986, 1999) and finally institutional theory (Scott, 1995, 2008, Kostova, 1997, Busenitz *et al.* 2000, Prieto *et al.* 2010). Building the model on a wide range of theoretical foundations ensured that the most relevant factors affecting entrepreneurial intentions were considered with the view to obtaining a finer grained understanding of the "black box" - farmers' RE investment intentions. The intentions process model was developed:

1. To test the influence of the farmers' capacities and farm resource situation on farmers' perceived self-efficacy, perceived desirability of RE production enterprises and on RE investment intentions;
2. To examine the influence of regulatory, cognitive and normative institutions on farmers' perceived self-efficacy, perceived desirability of RE production enterprises and on RE investment intentions;
3. To examine the possible existence of co-dependencies between different dimensions of the country's institutional profile on farmers' investment intentions;

4. To assess the level of influence of farmers' perceived self-efficacy and perceived desirability of RE production enterprises on RE investment intentions;
5. To examine the mediation effect of attitudes towards entrepreneurship on the effects of external institutions and resources on RE investment intentions.

1.5. Summary of the research methodology

Given that the aims of this study were descriptive (1-4) and causal (5) in nature, an appropriate research design was developed. An initial pilot survey of 7 farmers in the West Midlands led to the development of the data collection instrument. A pre-test was realised by visiting the seven farmers involved in the pilot survey and validity was also ensured by subjecting the instrument to scrutiny by researchers knowledgeable in RE and entrepreneurship research. In developing the data collection instrument especially with regards to determining the factors affecting entrepreneurial intentions, care was taken to build in constructs from established studies. A few modifications were made after the pre-test leading to the postal questionnaire survey of 2,000 farmers randomly selected from a list of 5,111 active members of the NFU in the West Midlands Region of the UK. A total of 393 usable responses were obtained representing a response rate of 20.1% which was judged acceptable. Non-response bias and representativeness analysis revealed that the sample was broadly representative of farmers in the UK when compared to some official DEFRA 2009 and Farm Business Survey (FBS) 2010/2011 agricultural statistics and hence generalisability of research findings was ensured.

As suggested earlier, the first four aims of the study required mainly descriptive analytical techniques while the fifth required more complex statistical techniques because it was concerned with hypotheses testing and establishing statistical relationships between the factors identified in the research model to influence investment intentions. The model presented in section 2.8.4 chapter 2 proposed that investment intentions were influenced by

external variables (the farmer/farm resource base, institutional) as well as individual level cognitive variables. To proceed with the analysis of effects, validity and reliability analysis of the constructs was performed. In the first instance, the items developed to measure the institutional dimensions, were subjected to principal component analysis (PCA). PCA revealed five uni-dimensional constructs with adequate internal reliabilities (Cronbach alphas above 0.60 – Brace *et al.* 2009). 10 items designed to measure individual attitudes towards entrepreneurship were also subjected to PCA. The items loaded cleanly on two dimensions as expected and internal reliability analysis also showed that the factors were very adequate. Given that the measures of the farmers' traits and farm business characteristics were ordinal and nominal variables, dummy coding was undertaken following the procedure established by Hair *et al* (1998). After verifying that the assumptions for regression analysis were met, statistical analysis was undertaken using a combination of multivariate linear regression and path analysis to test for different effect hypotheses. Mediation analysis was undertaken using the approach proposed by Baron and Kenny (1986).

1.6. Contributions of the study

This study seeks to contribute to knowledge in a number of important ways. Firstly, fill an important knowledge and research gap with regards to the factors which trigger entrepreneurialism in the UK farm sector specifically with regards to investment in RE enterprises. In effect, the adoption of bioenergy technologies should be understood in the context of other RE options available to farmers. While earlier research has compared the viability of biomass production enterprises against traditional agricultural enterprises, there is lack of understanding of the strategic preferences of farmers regarding other RE enterprises (Clancy *et al.* 2011, Wüstenhagen and Menichetti, 2012, Tate and Mbzibain,2012). The study should help uncover the levels of uptake of RE on UK farms,

determine the strategic preferences with regards to the types of RE production and associated enterprises of interest to farmers.

While attempts are being made to scale up deployment in the agricultural sector, there is little understanding of the experiences of early adopters of these enterprises, or the factors which may have influenced their decision-making. Given the potential influence of early adopters on non-adopters, such understanding may be critical in shaping the way support is provided to this sector (Panoutsou, 2008). This investigation could contribute to improve understanding of the role of RE production on farm business performance and farmers' motivations for engagement.

To more deeply investigate the future behaviour of current non-adopters of RE enterprises, this study develops and tests a novel comprehensive RE investment intentions model drawing from a wide range of theoretical fields than has been done previously in RE policy and farm entrepreneurship research. By considering a wide range of constructs derived from a range of theoretical fields, the research seeks to capture the influence of informal and formal institutional, resource and perceptual cognitive factors on entrepreneurialism on UK farms. In this regard, it seeks to contribute to knowledge by testing a multidimensional measure of the country's institutional profile which it is argued affects entrepreneurial intentions in agriculture. Additionally, it aims to test for the existence of co-dependencies amongst the different institutional measures as posited by Spenser and Gomez (2004).

It is widely acknowledged in the literature that individual perceptual cognitions towards entrepreneurship influence intentions (Bandura, 1977, 1986, 1989, Shapero and Sokol, 1982, Krueger, 1993) and hence entrepreneurial behaviour (Azjen, 1991). Kim and Hunter (1993) have argued that individual perceptions towards entrepreneurship can be influenced by external situational factors, which leads to the argument by Shapero and Sokol (1982)

and Krueger (1993) that situational factors influence entrepreneurial behaviour only to the extent that they impact on individual cognitions towards entrepreneurship. One of the objectives of this study is to examine the influence of a rich set of exogenous measures on entrepreneurial intentions and to determine the extent to which individual perceptual cognitions notably perceptions of self- efficacy and perceptions of desirability mediate the impact of exogenous institutional and resource factors on RE investment intentions as posited by past research (Shapero and Sokol, 1982, Krueger, 1993, Krueger *et al.* 2000, Azjen, 1991, Bandura, 1977, 1986, 1999). Understanding the underlying framework conditions supporting entrepreneurial activity is an issue of tremendous importance to scholars and policy makers (Stenholm *et al*. 2011).

Carter (1998) and Willock *et al* (1999) suggest that farmers are a rich reservoir for research which is often neglected. Literature on the emerging area of farm entrepreneurship is scarce as calls for research have not led to widespread investigation (McElwee, 2006). By bringing together literature from the separate areas of "farm" and "entrepreneurship" this study contributes to fill this gap. The next section concludes this chapter as well as shows the organisation of this document.

1.7. Organisation of the thesis

This chapter is the first of 6 chapters in this study. The following chapters are organised as follows:

Chapter 2 explores the literature surrounding the issues around the development of RE in the UK and the farm sector more specifically. It is divided into two parts: the first reviews literature on the RE policy, types of RE enterprises, the drivers and constraints to RE development. The second part presents the theoretical foundations of the study, develops the research model and research hypotheses.

Chapter 3 presents the research design and methods used in the thesis highlighting the advantages and limits of the methods used. A two phased sequential quantitative approach was used in this study. This chapter presents the pilot and the quantitative data collection phases of the study with details of the questionnaire development process, the pre-test, operationalisation of model variables. The sampling frame used in this study was the National Farmers' Union West Midlands data base. The response rate for the postal survey was 20.1%, non-response bias and representativeness analysis reveals that the sample is largely similar to official farm sector statistics from DEFRA and the Farm Business Survey. The reliability and validity of model constructs are ensured through principal component analysis (PCA) and internal reliability analysis. The chapter ends with a presentation of the data analysis techniques used in the study and a discussion of the validity and reliability of the research design adopted.

Chapter 4 presents the results and findings of the study. It highlights the level of attainment of the research aims. **Chapter 5** discusses the results and findings of the study alongside existing research outcomes. It highlights areas of convergence and divergence but also stresses the contributions of the study to knowledge. The chapter presents the research, theoretical and practical implications of the study. **Chapter 6** concludes this study. It reviews the issue under investigation, shows the contributions of the study, the weaknesses and proposals for further study. The next section (chapter 2) presents the literature review and develops the conceptual framework and the research model.

Chapter 2: Literature review and development of the research model

2. Introduction

This chapter reviews relevant literature on issues surrounding the development of RE ventures on UK farms in order to identify a knowledge gap and to refine the research questions and objectives to guide this study.

This chapter is split into two parts. **Part one** Sections 2.1 to 2.3 discuss the UK policy targets with respect to energy and climate change objectives and bring to the fore the role/potential role of the farm sector in achieving government objectives. This section ends with the view that the current level of deployment of RE on UK farms is far below expected levels and hence its potential contribution to government policy targets is unlikely to be achieved. In addition, it is observed that the farm sector's role has not been fully addressed by research especially with regards to the farmer's perspective of the problem.

Sections 2.4 and 2.5 present the types of RE ventures accessible to farmers and discuss the critical question of whether these types of ventures are viable alternative investment options for farmers. The drivers and barriers to RE development are also discussed.

Part two of the chapter starts with section 2.6 and presents definitions of entrepreneurship and farm entrepreneurship. It observes the fact that entrepreneurship is a multifaceted concept without a single accepted definition. Farm entrepreneurship is defined and investment in RE ventures is defined as being entrepreneurial in nature. The critique of relevant literature in this section argues that farmers have always been entrepreneurial and

hence methods of study used in small business and entrepreneurship research can be applied to the farm sector. The section highlights the marginalisation of the farm sector in entrepreneurship studies noting the paucity of knowledge with regards to the triggers of new venture creation in the farm sector.

Sections 2.7 to 2.8 present the theoretical foundations for the study. These sections explore the possible factors which influence/trigger new venture creation amongst entrepreneurs. These sections draw from the resource based view of the firm, the theory of planned behaviour, entrepreneurial event/intentions models, and social cognitive theory literature as well as on institutional theory. A review and critique of these theories, and their application to entrepreneurship research, leads to the development of a comprehensive conceptual framework for the study which furthers the frontiers of research and provides the guide for the continuation of the study. A number of research hypotheses are developed from the conceptual framework in section 2.8.5.

Chapter 2: Part I

2.1. European Union Level RE Policy framework

Energy accounts for 80% of all GHG emissions in the EU. Faced with the challenges of climate change, increasing dependence on fossil fuels and high energy prices, the EU has laid the foundation for transition to a low carbon economic region (EC 2007a, EC 2007b). The review and amendment of the 2001/77/EC and 2003/30/EC energy directives and the adoption of the DIRECTIVE 2009/28/EC on the promotion and use of renewable sources outline the EU's renewable commitment, sets targets for its Member states, and defines mechanisms to achieve stated objectives. By 2020, the EU and Member states are expected to procure 20% of energy requirements from RES and 10% share of energy consumption in transport from RES. Member states are obligated by the DIRECTIVE 2009/28/EC to produce national renewable energy action plans which detail how they intend to achieve their targets (EC 2007b, EC 2009a, EC 2009b).

2.2. UK climate change and energy targets

The 2008 Climate Change Act (CCA) defines the target and vision of the UK to achieve its aims of reducing GHG emissions. The main target of the UK according to the CCA is to reduce the rate of CO_2 emissions by 80% by 2050 and 26% by 2020. The importance of energy to UK development and overall government commitment is further emphasized in other energy objectives:

1. Maintain the reliability of energy supplies;
2. Promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve productivity; and
3. Ensure that every home is adequately and affordably heated (DFT, 2003).

More specifically this includes:

- ✓ 30% of electricity from renewable sources, compared with 5.4% in 2008;
- ✓ 12% of heat from renewable sources; and

- ✓ 10% of energy used in transport from renewable sources (DECC, 2010a).

The UK energy sector contributes about 5% of the Gross Domestic Product (GDP) and represents up to 41% of industrial investments in the economy and provides employment to a large section of the population (BERR, 2008). The challenging issue is that the UK moved from a position of net energy exporter to that of a net energy importer since 2004 when it imported about 5% of consumption (Perry and Rosillo-Calle, 2008).

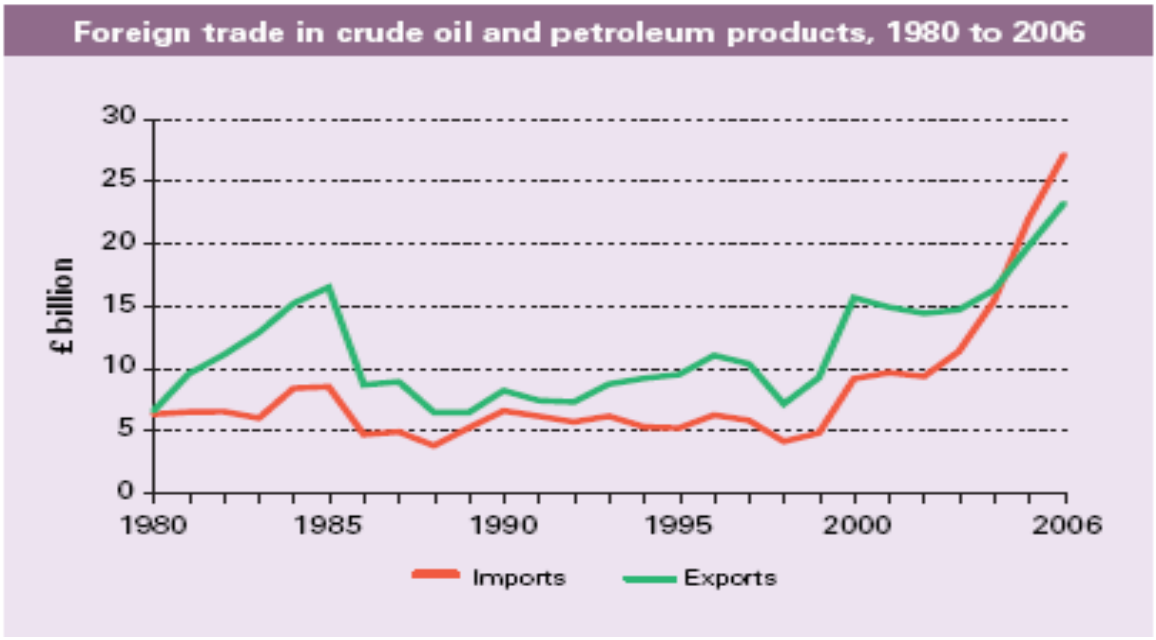


Figure 2.1: UK energy trade balance 1980-2006
Source: (BERR 2007).

Increasing the use of RE offers an important option for fuel source diversification and should help reduce the country's dependency on imported and increasingly expensive fossil fuels (DECC, 2009a, DECC/DFT/DEFRA, 2012, DFT, 2003, DFT, 2007, DFT, 2009). Some researchers argue that this can be made possible through partnerships between the public and the private sector as each has a role to play (Masini and Menichetti, 2012). The UK Government is looking to the farming industry to play a substantial role in this direction especially because RE offers important opportunities and potential farm enterprises that could be viable long-term contributors to farm business survival (DEFRA,

2007b, NFU, 2005, Rowe *et al.* 2009, DEFRA, 2012). Through RE production, farm business can be stabilised; production diversified and farm enterprises allowed to stay in the agricultural business (Plieninger, 2006). It is estimated that for the UK to meet its legally binding target of 15% of overall energy by 2020, 30% of this requirement will be achieved through bioenergy production and much of the biomass is expected to be supplied by the farm sector (DEFRA, 2007, DEFRA, 2012).

Traditionally, agricultural land is used for the production of food and feed for human and animal welfare (Tsai, 2009). However, increasing attention to RE on farms has created/strengthened links between agriculture and other policy fields especially energy (Lynch, 2009). The latest estimates from the UK Government's Biomass Strategy suggest that it will require the cultivation of between 9 300 Km^2 to 36 300 Km^2 of energy crops in England and Wales to reach the expected contribution from bioenergy production up from about 10 000 Km^2 in 2010. To reach the targets for bioenergy requires a yearly increase of 20% in the surface areas planted which would correspond to between 6% and 24% of the total land area in England and Wales or 9% to 35% of land currently under some form of agricultural production. This is only possible if planting rates were to increase significantly it is argued (DECC/DFT/DEFRA, 2012). Some of this land is expected to come from set-aside land since the set aside scheme of the CAP encourages production of energy crops on them under its two pillars to support farmers and rural areas (Rowe *et al.* 2009). The conversion of crop lands to energy crop production has also been suggested as a means to scale back farm subsidies and further reduce excess food production (Berndes and Hansson, 2007). For example in the 2000 CAP reform energy crops became eligible for the same payments as cereals as long as the energy crops were produced on set aside or regular land (Ericsson *et al.* 2009). The 2003 CAP reforms introduced energy crop subsidy of 45€$ha^{-1}yr^{-1}$ as long as the crops were grown on regular land (estimated at 2 million ha)

corresponding to an income to the farmer of $0.30€J^{-1}$. The ongoing reform of the CAP is seeking to establish an agricultural sector which is:

1. Internationally competitive without need for subsidies and protection;
2. Rewarded by the market for its outputs with support by the tax payer limited to the delivery of social benefits the market cannot deliver;
3. Environmentally sensitive while maintaining and enhancing the landscape and tackling climate change; and
4. Socially responsive to the needs of rural communities (DEFRA, 2007, p.23).

Investment in RE enterprises is being promoted as an integral part of the strategy to achieve the aims of the CAP through a series of Rural Development Programme initiatives (Natural England, 2011, Nix, 2012, Natural England, 2009).

While many authors argue that RE production can be successfully integrated with agricultural farming systems (Plieninger, 2006), there are also concerns that increasing allocation of agricultural lands can have negative impacts on food production and food security at national and international levels (IFPRI, 2006). Research has shown that the international 2008 world food price crisis was triggered by increasing use of agricultural produce for ethanol production in the US and other EU countries. Other concerns including loss of biodiversity, erosion, landscape quality loss etc. have been raised by (DEFRA, 2007, NFU, 2005, Rowe *et al.* 2009, Kaditi, 2009). Clearly, converting land to energy production has its costs as land is taken way from agriculture and from other sectors.

While agriculture seems to provide answers to climate change and energy problems, the sector is also a major contributor to greenhouse gas emissions in the UK. According to the DECC, agriculture and other land use changes are responsible for 7% of the total GHG emissions (DECC, 2011b). The main source of these emissions is from the livestock sector

(methane) and there are national targets to reduce the emissions from agriculture to 6% (baseline year 2008) (Nix, 2012).

2.3. UK Government Policies and Regulations

In the following, the major policies affecting the development of RE in the UK are discussed.

2.3.1. The Renewables Obligation (RO)

The RO mechanism was introduced in 2002 as a system of tradable permits or renewable obligations certificates (ROCs) administered for the government by the Office for Gas and Energy Markets (Ofgem) (DECC, 2009). Through this mechanism electricity generators have a legal obligation to produce a certain percentage (quota) of electricity from eligible RES. These include land fill gas, sewage gas, onshore and off shore wind, photovoltaics, hydro (20MW or less, or larger commissioned after April 2002), geothermal, tidal and tidal power stream, wave power (DECC/DFT/DEFRA, 2012). Generators must demonstrate compliance to Ofgem through the publication of renewable electricity outputs in return for Renewable Obligations Certificates (ROCs). They are allowed to do so either through own production or they can buy the ROCs from other generators to make up their quotas. Farmers generating electricity can sell the ROCs to other electricity generators as they have no obligation to keep them (Nix, 2012).

In case a supplier or generator fails to produce the required quota, they are expected to pay a buyout price. The buyout price is adjusted each year by Ofgem based on the past figures by the Retail Price Index (RPI) and for inflation. This percentage increases yearly as depicted in table 2.1.

The buyout fund is managed by Ofgem and the funds accumulated are redistributed to operators that were able to respect their quotas.

Table 2.1: Evolution of total obligation as regards the supply of electricity from RES by generators

Year	Renewable obligation target (ROCs per 100 MW) %	Non-compliance penalty per MWh (buy out price)	Average value of ROCs
2010/11	10.4	£34.99	£48.10
2011/12	11.4	£38.69	£50.94
Annually thereafter to 2015/16	+1 15.4	Index linked increments	Market price

Source: Nix, 2012

The RO mechanism was technology blind at conception and therefore did not consider the different levels of maturity of the RE technologies available and favoured mainly electricity based technologies (Mitchell and Connor, 2004). The RO scheme was more favourable to large scale projects (DECC, 2010a). A review of the mechanism led to the introduction of the notion of bands. Banding recognises that technologies have different production costs; are at various levels of maturity, and overall vary in their contribution to greenhouse gas savings (DECC, 2009c). For the agricultural sector, banding represents an important opportunity given that biomass related technologies receive higher number of ROCs/MWh of RE produced.

In order to drive up the bioenergy market, co-firing of biomass in fossil fuel power stations was also added into the list of eligible technologies for the RO mechanism. Power stations are allowed to substitute for up to 25% of fossil fuels with biomass without changes to the fossil energy plants. Based on its potential to drive up the demand for biomass, power stations are given the chance to use as much of energy crops as possible as substitute for fossil fuels. This limit was set at 10% from between April 2006 and March 2011 and 5%

from between April 2011 to March 2016 (BERR, 2008). According to Taylor (2008) the acceptance of co-firing in power stations represents a potential market opportunity for the biomass industry especially energy crops. A knowledge gap exists with regards to the extent to which farmers would actually choose to grow these crops (Clancy *et al.* 2012).

2.3.2. The Renewable Heat Incentive (RHI)

Heat accounts for more than 47% of UK total energy consumption (DECC, 2011a). More than half of this is consumed by the residential sector (53%) followed by the industrial sector (28%). The agricultural sector accounts only for about 1% of overall demand or consumption. Government's target for 2020 is that 12% of national heat will come from RES. Because the value for heat is quite low (1-2p/KWh thermal energy) (Nix, 2012), investments in this area are hardly justified on economic terms and the introduction of the RHI in 2011 was expected to change the situation and make RE heat generation viable (DECC, 2010b, c). Table 2.2 shows the number of installations under the RHI in England as at 25.05.2012.

Table 2.2: RHI public report

Technology Type	No of accredited installations	Installed Capacity (MW)
Biogas	0	0.000
Solid Biomass Boiler	54	19,656
Deep Geothermal	0	0.000
Ground Source Heat Pump (GSHP)	1	0.010
Municipal Solid Waste	0	0.000
Solar Thermal	1	0.008
Water Source Heat Pump (WSHP)	1	0.024
Bio-Methane	0	0.000

Source: Ofgem-Eservice (2012)

The RHI is being rolled out in two phases: phase 1 targeting domestic installations started in July 2011 and the second phase for non-domestic installations is expected to commence in 2012. In the first year premium payments are made to cover the costs of installation of eligible technologies and thereafter tariffs are paid for a period of 20 years. Since the beginning of the scheme a total of about £219,000 has been paid out to renewable heat producers (Ofgem, 2012).

2.3.3. Feed-In- Tariffs (FITs)

The FITs scheme was launched on the 1st of April 2010 and is aimed at encouraging small scale RE electricity production at all levels up to 5MW capacity (DECC 2010a). It is expected that the scheme will provide support for the installation of up to 750,000 small scale electricity generation units and help save up to 7 million tonnes of CO2 by 2020. The scheme comprises of two types of payments made to electricity generators, and paid for by licensed electricity suppliers. The first element is a **generation tariff** which is set at different levels depending on the technology, start data and by scale. The price per unit is paid to the generator whether the electricity is used on site or exported to the local grid/network. The second element is an **export tariff** which is either metered or paid as a guaranteed amount that eligible generators are eligible for. The generator may decide to use the electricity onsite and therefore avoid to buy electricity from own supplier or as the case may be decide to export all or part of the electricity generated at a guaranteed price of 3p/kWh (2011/12). Generators with a capacity of below 50kw (microgenerators) are eligible for FITs, while those with capacities between 50kW and 5MW have the option to choose between the FITs and the RO. Generators cannot claim both and FITs are paid for a period of between 20-25 years. Since the instruction of the FITs scheme in April 2010, Ofgem's FITs annual report for the period April 2010 to 30 March 2011 shows that 30,201 installations were put in place with a total electricity production capacity of 108.3 MWh.

68,559.4 MWh of electricity was generated during this period. Table 2.3 shows the RE technologies that are eligible for FITs payments.

Table 2.3: Eligible RE technologies for FIT payment rates

Tariff name	**Eligible technology**	**Eligible sizes**
Small biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	Less than 200 kWth
Medium biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	200 kWth<less than 1,000 kWth
Large biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	1,000 kWth and above
Small ground source	Ground-source heat pumps; Water-source heat pumps; deep geothermal	Less than 100 kWth
Large ground source	Ground-source heat pumps; Water-source heat pumps; deep geothermal	100 kWth and above
Solar thermal	Solar thermal	Less than 200 kWth
Biomethane	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200 kWth

Source: DECC (2011a, p. 51)

According to Ofgem (2011), photovoltaic technologies were by far the most prevalent followed by wind energy installations put in place between 2010 and 2011. Of the 30,201 RE production installations reported there were 29,265 domestic, 489 in non-domestic/commercial, 44 non-domestics/industrial and 403 community owned schemes. The distribution of installations by type of technology can be seen in figure 2.2 below.

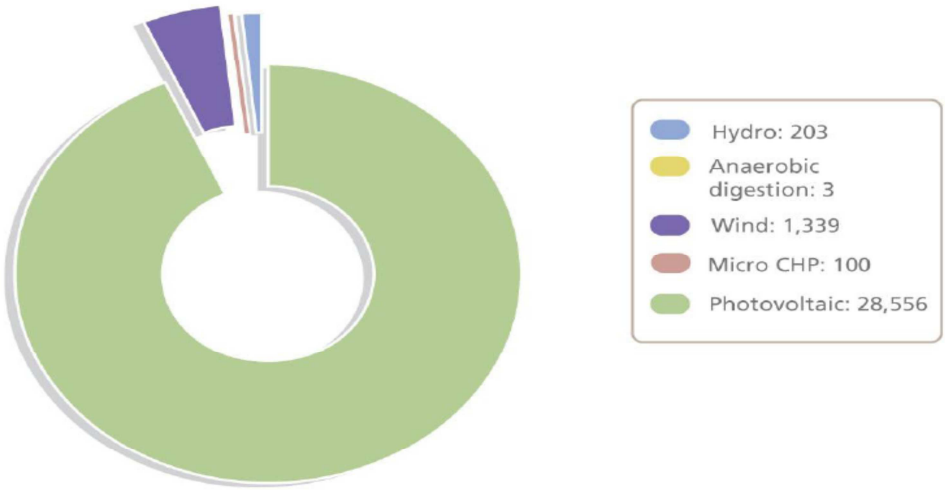


Figure 2.2: Number of FITs installations by technology
Source: Ofgem (2011, p.12)

Given the rapid take up of photovoltaic technologies in the domestic sector, the generation tariffs for photovoltaic were reviewed in August 2011 as the government deemed that the tariffs were too generous and financially unsustainable. Table 2.4 shows the new government proposals.

Table 2.4: Proposed new generation tariffs for photovoltaic

Band (kW)	Current generation tariff (p/kWh	Proposed (p/kWh)
≤4kW (new build)	37.8	21
≤4kW (retrofit)	43.3	21
>4-10kW	37.8	16.8
>10-50kW	32.9	15.2
>50-100kW	19	12.9
>100-150kW	19	12.9
>150-250kW	15	12.9
>250kW-5MW	8.5	8.5*

* Current tariffs which we are not being changed. Like all other current tariffs, will be adjusted in line with the Retail Price Index from 1 April 2012.
Source: DECC (2012)

2.3.4. Renewable Transport Fuel Obligation (RTFO)

The RTFO scheme is quite similar to the RO. The RTFO was introduced in April 2008 as a means to achieve the RE Directive target to have 10% of UK transport fuel coming from RES by 2020. The RTFO is administered for the government by the RE Association. This scheme targets fossil fuel suppliers who supply more than 450,000 litres per year. They are expected to produce part of their fuel for road transport from RES. These obligations have been set at 4% for 2011/12, 4.5% for 2012/13, and 5% for 2013/14. Like the RO, suppliers can comply by supplying their share of fuel from RES, obtaining certificates from other suppliers or paying a buyout price. The buyout price is set at 15p/litre (l) and will rise to 30p/l in the next years.

2.3.5. Support and Grants

This section presents the main support and grant schemes available for farmers interested in biomass production in the UK.

2.3.5.1. The Energy Crops Scheme (ECS)

This is part of the Rural Development Programme for England managed by Natural England. It finances the establishment of Miscanthus and Short Rotation Coppice that is grown for own use or to supply power stations. The grant covers 50% of the establishment costs and a minimum of 3 ha can be claimed. Any land is eligible for the ECS programme but not land already under forestry, energy crops or common land. Table 2.5 shows the level of support for the establishment of energy crops in the UK between 2000 and 2006.

Table 2.5: The level of deployment of energy crops between 2000 and 2006

UK Region	Miscanthus area (ha)	Total grant paid for Miscanthus	SRC area (ha)	Total grant paid for SRC
East Midlands	1889.88	£1,737,972.00	609.31	£596,653.50
Yorkshire and Humberside	1842.67	£1,694,520.40	463.60	£469,702.00
South West	1036.10	£953,212.00	30.52	£30,520.00
West Midlands	**858.89**	**£790,169.60**	**26.58**	**£27,750.00**
East of England	380.67	£346,582.40	75.50	£75,500.00
South East	305.33	£280,903.60	256.62	£257,040.00
North West	62.55	£57,546.00	124.66	£122,860.00
North East	0	0	228.15	£231,522.00
Total	6376.09	£5,860,906.00	1814.94	£1,811,547.50

Source: Natural England (2011b)

Table 2.5 shows that more support has been paid out to Miscanthus growers than SRC producers. The figures show that the West Midlands Region came 4th in terms of receipt of establishment grants for Miscanthus and 8th with regards to establishment of SRC.

2.3.5.2. The Bioenergy Capital Grants Scheme

The bioenergy capital grant scheme is in its 6th round since after it was launched in 2006. The aim of this scheme is to provide capital grants towards the cost of equipment in complete biomass fuelled projects in the UK. This scheme targets initiatives directed to space, water or process heating; or combined heat and power (i.e. the supply of electricity, or mechanical power, and space, water or process heating (DECC, 2009b). The capital grants cover up to 50% of the cost of the installations with the maximum amount established at £500,000 per installation.

2.4. The incidence and types of RE production enterprises accessible to farmers

The adoption of bioenergy technologies should be understood in the context of other RE options available to farmers as farmers' choices are bound to be influenced by their preferences (Mbzibain *et al.* 2011). Extant literature shows that the decision is often framed as involving the choice between energy crops and conventional agricultural enterprises (Clancy *et al.* 2011, Sherrington *et al.* 2008, Sherrington and Moran, 2010) and little is known about farmers' preferences with regards to other types of RE (Tranter *et al.* 2011, Munday *et al.* 2010). Providing more clarity to investment strategic choices is relevant as it may facilitate policy maker's role of allocating resources to technologies that are of interest to investors and avoid mismatches between government and investor preferences (Wüstenhagen and Menichetti, 2012, Clancy *et al.* 2011). Very recent evidence suggests that in effect, investors have strategic choices for investment in RE as investment decisions are found to be significantly related to the types and consistency of policy incentives (Masini and Menichetti, 2012). A number of RE production options are available to farmers including biomass production, anaerobic digestion, combined heat power, hydro, solar and wind as shown in table 2.6.

Table 2.6: Percentage of farms producing RE from RE sources and UK region in 2010

Renewable source	% of holdings producing RE	No of holdings
Any other biomass[b]	46	2,343
Biomass to produce biogas[a]	44	2,247
Solar	34	1,706
Wind	11	537
Hydro - energy	1	50
Any other RES	17	883

a) Percentages based on the total number of holdings that produce RE
b) E.g. slurries, food and plant waste for anaerobic digestion
c) E.g. Miscanthus, willows, wood wastes

Source: DEFRA (2012).

Table 2.6 shows that biomass production is the most popular source used for producing RE in the UK farm sector (DEFRA, 2012). Energy crops (oil rape seed, short rotation coppice, Miscanthus, giant grass, green manure crops etc.) are the most common energy plants that farmers can grow in Europe while sugar dominates as an energy crop in Brazil (IFPRI, 2006). Farm activity also produces residues which can be supplied to biomass conversion plants be they primary, secondary or tertiary residues (Faaij, 2006) as illustrated in table 2.6. Farmers can also produce permanent grass for anaerobic digestion (Prochnow *et al.* 2009). The forestry and wood based industry provides another interesting option for farmers. This is either in the form of wood chip production for heating or the use of wood residues from forest exploitation or from the paper industry (Taylor, 2008).

The development of anaerobic digesters (AD) for RE production on farms is still in its infant phase in the UK (Dagnall, 1995) but is highly developed in the Netherlands (Gebrezgabher *et al.* 2009) and Germany (German Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2004, German Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2009). The history of AD on UK farms dates back to the 80s. According to Dagnall (1995), both the former Department of Energy and the Ministry of Agriculture (MAAF) supported research and development programmes (R&D) to assess the technical and economic viability of AD on UK farms. Reviews up to the 90s revealed that even though the technology was technically viable, the experience of AD on farms was poor either due to biogas yields, insufficient dry solids in feed stocks and limited on farm demand. There is however, renewed interest in this technology as laid out in the UK 2012 biomass strategy and the renewable energy road map given the potential. The NFU plans to encourage members to put in place 1,000 anaerobic digesters on farm and 100 waste AD units by 2020 (Turley, 2008). AD has a long history in the United States of America where it has been applied in the last decades on farms (Ernst *et al.* 1999). Ernst and the others draw the general conclusion that in many

cases, AD is not adopted on farms only for profit purposes but also to reduce negative externalities related to their business operations and conform to the demands of the community.

The use of solar energy in farm space heating is an important way to improve firm performance in terms of energy savings and income generation (Mumba, 1995, Talavera *et al.* 2010). Germany has one of the widest applications of this technology with its 100, 000 roof programme sponsored by the German government. Dautzenberg and Hanf (2008), note that the German bioenergy sector has a strong grounding on small scale projects run by single farmers and bioenergy associations. Table 2.6 shows that solar energy production is the second most prevalent type of RE source on UK farms followed by wind.

With regards to wind energy production, it has been estimated that about 200 Km^2 of land could be allocated to wind turbines in the UK to be able to produce 45 TWh of electricity. This land area could also be used for other activities including farming (Howard *et al.* 2009, The Cooperative Bank Plc, 2010). It is also possible that farmers contract their farmlands for the installation of wind turbines on farms. The Cooperative Bank has successfully assisted farmers to develop and install wind turbines in their fields and farmers are able to generate electricity and sell to energy agencies (The Cooperative Bank Plc, 2010).

Combined heat and power technologies are designed to generate electricity and heat through direct combustion or burning of biomass. Electricity is often the major output of these systems but trapping the heat and using it is important for the scheme's economic viability. In some cases, this might involve combination with coal. Biomass combustion with coal has been proposed as an important means to drive up biomass production in the UK considering that CHP plants are allowed by the government to replace up to 25% of

their coal resources with biomass without important modifications to the operation of their plants (DECC, 2009). Farmers have the option to contract production of biomass for these plants. Contract farming has been proven to reduce uncertainty amongst farmers improving production, productivity and market access for energy crops (Sherrington *et al.* 2008).

2.5. Constraints and drivers of RE development

Barriers increase the risks and uncertainty related to RE development and in some cases scales up the operating costs- thereby reducing the economic viability and attractiveness of investing in the sector (Wüstenhagen and Menichetti, 2012). Other research has also found that liquidity and price risks are important factors influencing the adoption of Miscanthus and switch grass in France (Bocqueho and Jacquet, 2010). In another recent study, Thornley and others identified the lack of financial incentives for initial costs of Miscanthus production to be the main barriers to RE production adoption (Thornley *et al.* 2009).

In a UK study of barriers to and drivers for UK bioenergy development researchers identified four stakeholder groups and proceeded to compile lists of barriers and drivers from existing literature (Adams *et al.* 2010). Farmers and biomass suppliers identified the ability to 'make a profit' as the most popular driver and demonstrated the necessity of having economic viability as a sound basis for investment. Other significant drivers included the long term attractiveness of the potential of a growth market, contribution to climate change mitigation and the replacement of fossil fuel sources. Barriers to the development of bioenergy projects included technology, development and operational costs and the impact of legislation. Similar results were obtained with regards to AD adoption in the UK were it was found that perceived high capital costs coupled with doubtful overall financial viability were key barriers (Tranter *et al.* 2011). Table 2.7 shows

a summary of research that has specifically looked at the drivers and barriers to RE deployment in Europe and the UK more specifically.

Table 2.7: Barriers and drivers of RE investment

Author (s)	Barriers	Drivers and research focus
DECC/ DFT/ DEFRA (2012)	Economic, farmer acceptance, social acceptance, technology costs	RE policy, markets
Adams *et al* (2011)	Technical, financial, social and others	Financial support, market opportunities, need for diversification, profitability, CO2 emissions reduction
Domac *et al* (2005a)	Uncertainty about financial viability of energy crops; uncertain government support for farm establishment, low energy crop prices, deferred income flows for perennial energy crops, prospective clients have limited knowledge, undeveloped markets	Potential financial returns, UK
McCormick and Kåberger (2007)	Economic conditions, knowhow, institutional capacity, supply chain coordination	Sweden, UK, Italy and Austria,
Rösch and Kaltschmitt (1999)	Difficulties with funding, financing and insuring, Unfavourable administrative conditions, Organisational difficulties, Lack of knowledge and adequate flow of information, Insufficient perception and acceptance	EU
Roos *et al* (1999)	Integration, Scale of operation/effects, Competition in the bioenergy sector and other businesses; National policy; and Local policy and opinion	EU

Chapter 2: Part II

2.6. Defining farm entrepreneurship

The resurgence of interest in entrepreneurship by policy makers can be traced to the benefits that are widely believed to be associated with it. These benefits include contribution to economic growth, progress, job creation and innovation (Kent, 1984, Reynolds *et al.* 1994). The role of entrepreneurship in contributing to these goals has been subject of widespread academic research (e.g. Kizner 1984, Bull and Willard 1993, Shane and Venkataraman, 2000). Dean and McMullen (2007) argue that entrepreneurship can also play a significant role in addressing concerns of environmental degradation and climate change through the exploitation of opportunities that are created by relevant market failures (e.g. externalities, information asymmetries, failure of government intervention etc.) yet this has attracted very little attention from entrepreneurship researchers. This view is echoed by Hall *et al* (2010, p.439) as they point out that:

> 'there remains considerable uncertainty regarding the nature of entrepreneurship's role in the area, and the academic discourse on sustainable development within the mainstream entrepreneurship literature has to date been sparse'.

In order to provide a definition of farm entrepreneurship requires clarification of the phenomenon of entrepreneurship.

2.6.1. What is Entrepreneurship?

According to Bull and Willard (1993) over 200 years of the study of entrepreneurship have provided several definitions of the word "entrepreneur" but there is no consensus amongst scholars as to what constitutes entrepreneurship or the entrepreneurial event (Kent 1984, Gartner, 1989). For this reason, Shane and Venkataraman (2000) argue that this represents the largest obstacle in creating a conceptual framework for the entrepreneurship field of study. Early definitions of entrepreneurship can be traced back to the Irish banker Richard Cantillon who operated in Paris in the eighteenth century. To Cantillon, the entrepreneur is

mainly a bearer of risk. Joseph Schumpeter (1934) describes entrepreneurs as individuals whose function was the combination of different means of production (Schumpeter, 1934). Building on the definition proposed by Schumpeter, Israel Kizner sees an entrepreneur as one who perceives what others have not seen and acts upon those perceptions. Kizner's entrepreneur is more than Cantillon's risk taker or Schumpeter's innovator but also includes being alert to opportunities for profit.

Following on from the early definitions, many others have been attempted. For Carland *et al* (1984) an entrepreneur is someone who establishes and manages a business for the principal purposes of profit and growth. Enterprise is characterised principally by innovative behaviour and will employ strategic management practices in the business. Gray defines an entrepreneur as an individual who manages a business with the intention of expanding it and with the leadership and managerial capabilities for achieving the business goals (Gray, 2002). According to Atherton an entrepreneur could be defined as somebody who creates new wealth and new opportunities via the acquisition and innovative use of existing resources (Atherton, 2004). This definition extends Carland *et al* (1984) objective of profit and growth to that of wealth creation to include broader aspects of social wellbeing and intangible assets that relate both to the venture and to the economy more widely. It is a view that is also supported by Rae who define entrepreneur as an individual who acts in an enterprising way, and who identifies and acts on an opportunity (Rae, 2007). Gartner defines entrepreneurship as the creation of a new organisation (Gartner, 1985, Gartner, 1989) while others suggest that enterprise can be understood as an economic activity and not necessarily a formal organisation unit (Davidsson and Wiklund, 2001, Low and MacMillan, 1988). Rae (2007) and Carland *et al* (1984) also contend that the pursuit of profit is important for entrepreneurship but is definitely not the sole determinant of entrepreneurship.

According to Atherton (2004) entrepreneurship needs to be understood as a state (being an entrepreneur) and a behaviour (being entrepreneurial). While being an entrepreneur denotes process, entrepreneurial relates to taking initiative and responsibility to deal and manage ambiguity, complexity and uncertainty. Holmes and Schimtz (1990) define an entrepreneur as one who responds to opportunities for creating new products (and the like) that arise from changes in the environment - technological, demographic, economic, etc. to achieve some self-defined objectives. Given the diversity of definitions, Low and MacMillan (1988) argue that because of the range of aspects captured by each definition of entrepreneurship, there is need for some common ground as none of the definitions captures all the dimensions of the concept. It is for this reason that they define entrepreneurship broadly as the "creation of a new enterprise" and suggest that entrepreneurship research should seek to explain and facilitate the role of new enterprise in furthering economic progress. Bruyat and Julien (2000, p. 168) contend that the role of researchers in the field of entrepreneurship is to penetrate the "black box" in order to:

- Understand or if possible, predict the phenomenon of new value creation initiated by individuals; and
- To understand or predict their success, failure or performance.

Such understanding of the "black box" as sought in this research should enable promotion of entrepreneurship and consequently social welfare benefits. This study subscribes to the Atherton (2004) definition of an entrepreneur but also to the fact that the objectives of the entrepreneur are not always economic in nature but extend to include improvements in social, cultural, health and environmental arenas (Dean and McMullen, 2002, Dean and McMullen, 2007, Rae, 2007, Wiklund *et al.* 2010). This study takes the view that enterprise is the creation of a new activity and not necessarily a new organisational unit (Carland *et al.* 1984, Low and MacMillan, 1988). Additionally, it is acknowledged that enterprise takes place within a context that shapes the decision of the individual to pursue or not to exploit opportunities (Zahra and Dess, 2001, Shane, 2003, Hisrich *et al.* 2010).

According to Shane and Venkataraman (2000) it is actually the tendency of some individuals and not others to respond to situational cues of opportunities that differentiate those who engage in entrepreneurial behaviour.

The argument that some individuals are entrepreneurial while others are not continues to be subject of immense research. That entrepreneurs were different from the rest of the population was subject of immense research between the 1960s and 1970s some of the most important being McClelland's 1961 research on risk taking and need for achievement (Alvarez and Busenitz, 2001). Examples of these studies including earlier attempts are captured by Carland *et al* (1984, p. 356) below.

Date	*Author(s)*	*Characteristic(s)*
1848	Mill	Riskbearing
1917	Weber	Source of formal authority
1934	Schumpeter	Innovation, initiative
1954	Sutton	Desire for responsibility
1959	Hartman	Source of formal authority
1961	McClelland	Risk taking, need for achievement
1963	Davids	Ambition; desire for independence; responsibility; self-confidence
1964	Pickle	Drive/mental; human relations; communication ability; technical knowledge
1971	Palmer	Risk measurement
1971	Hornaday & Aboud	Need for achievement; autonomy; aggression; power; recognition; innovative/ independent
1973	Winter	Need for power
1974	Borland	Internal locus of control
1974	Liles	Need for achievement
1977	Gasse	Personal value orientation
1978	Timmons	Drive/self-confidence; goal oriented moderated risk taker; internal locus of control; creativity/innovation
1980	Sexton	Energetic/ambitious; positive reaction to setbacks
1981	Welsh & White	Need to control; responsibility seeker; self-confidence/drive; challenge taker; moderate risk taker
1982	Dunkelberg & Cooper	Growth oriented; independence oriented; craftsman oriented

Looking at the work of Carland *et al* (1984) and Low and MacMillan (1988), early entrepreneurship studies typically focussed on the personality or the cultural background of the individual as determinant of entrepreneurial behaviour. Past research on the influence of traits on entrepreneurship to date continues to be mixed as researchers have failed to define a set of specific traits which differentiate entrepreneurs from business managers (Mueller and Thomas, 2001, Chen *et al.* 1998, Low and MacMillan, 1988). Low and MacMillan (1988) as well as Gartner (1989) suggest that any meaningful entrepreneurship research must move beyond traits and adopt a more contextual and process-oriented focus.

2.6.2. Entrepreneurship as a process

The failure of research on traits has moved attention from examining the person in entrepreneurship to the process (Gartner and Gatewood, 1992, Morris *et al.* 1994). According to Morris *et al* (1994), entrepreneurship is an input-output process comprised of attitudinal and behavioural components. The attitudinal component focuses on the willingness of an individual or organisation to embrace new opportunities and take responsibility, the behavioural component includes the set of activities required to evaluate an opportunity, define the business concept, assess and acquire resources and then operate and derive benefits from the venture (Stevenson *et al.* 1985). According to Kizner (1984) the entrepreneurial process is an endless process of discovery. The opportunities for discovery consist of the errors made by others trading in markets now or in the future as well as the discovery of unsuspected resources or technical feasibilities that make up an innovation. The process involves all functions, actions, activities associated with the perception of opportunities and the creation of new organisations to pursue them (Bygrave and Hofer, 1991). Process also refers to the foundation and development of entrepreneurial projects (Fayolle, 2002).

Shane and Venkataraman (2000) argue that the decision to exploit entrepreneurial opportunities is influenced by two factors: the nature of the opportunity as well as the individual level conditions. With regards to the nature of the opportunities, the authors contend that a number of dimensions are important. Firstly, the opportunity requires the entrepreneur to believe that the expected value of the entrepreneurial profit will be greater than the opportunity cost of the alternatives. Secondly, there should be demand for the products or services and the cost of capital to take advantage of the opportunity should be low. Considering the individual level factors, Shane and Venkataraman argue that people consider the costs involved in mobilising the resources needed to exploit the opportunity.

Past experience, transferability of knowledge to the new enterprise as well as individual perceptions are also key in the decision making process. For example, individuals with greater self-efficacy are more likely to exploit opportunities. Looking at the suggestions made by Shane and Venkataraman, they completely ignore the role of the external environmental forces as important antecedents to entrepreneurial activities even though widely reported to be critical in providing/creating opportunities and facilitating resource mobilisation (Zahra and Dess, 2001, Begley *et al.* 2005, Busenitz *et al.* 2000).

Gartner (1985) defines a conceptual framework for entrepreneurship process to include four important dimensions. Gartner suggests that the process should include the characteristics of the individual who starts the venture, the organisation, the environment surrounding the venture and the process which the new venture is created. Gartner's conceptual framework is extended by Bruyat and Julien (2000) as captured in figure 2.3.

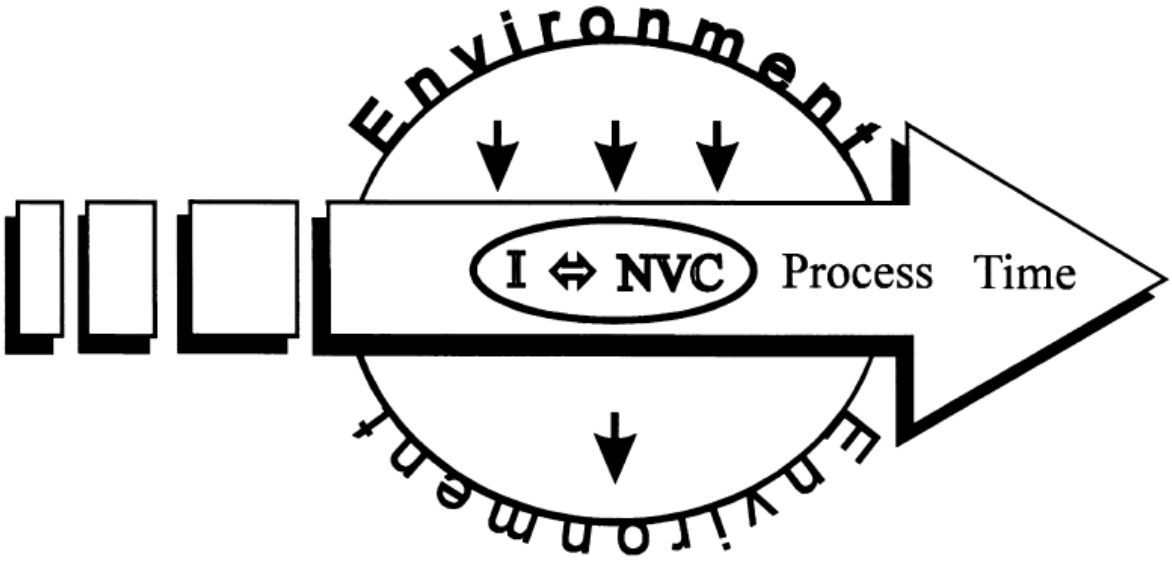


Figure 2.3: The entrepreneurial process located within an environment and time
NVC – New Venture Creation

The difference between Bruyat and Julien's framework and Gartner's is that rather than considered individually, Bruyat and Julien argue that in the entrepreneurial process, the individual and the object or venture created are in dialogue/interact with the environment

over time to create new value. Jack and Anderson (2002) adopt a structuration framework to explain the entrepreneurial process further stressing the importance of agency and context. They, like Bruyat and Julien (2000), argue that such an approach to studying entrepreneurship makes it possible to understand how the context/structure affects agency and how agency takes part in shaping the context. They suggest that the degree to which an entrepreneur is embedded in the social context affects their ability to draw social and economic resources with consequent impact on the nature of the entrepreneurial process and the entrepreneurial event (Jack and Anderson, 2002). Other examples of entrepreneurship process models are summarised in table 2.8.

Table 2.8: Examples of entrepreneurship process models

Author	**Focus**	**Important factors**
Ardichvili and Cardozo (2000), Ardichvili *et al* (2003)	Opportunity recognition and development	Entrepreneurial awareness, access to networks, prior knowledge of market and customer problems, self-efficacy
Bird (1988)	Actions and intentionality	Social, political and economic factors, personal history, personality factors and abilities mediated by thought processes
Boyd and Vozikis (1994)	Actions and intentionality	Social, political and economic factors, personal history, personality, beliefs and attitudes, self-efficacy
Morris *et al* (1994)	Entrepreneurship	Input and output factors
Hisrich *et al* (2010)	Entrepreneurial process	Identification and opportunity evaluation, business planning, determine resources required, manage the enterprise

Graphical representations of these models are presented in appendix 1.

Entrepreneurship is definitely a multifaceted phenomenon (Shane 2003, Low and MacMillan, 1988). It is argued that it is only by combining different perspectives of the phenomenon that a more comprehensive understanding can be achieved (Cunningham and Lischeron, 1991). Cunningham and Lischeron (1991) suggest that research activity in entrepreneurship can be clustered into six schools of thought depending on the research interest which within this study sums up the different definitions of entrepreneurship that have been discussed in this section.

Table 2.9: Different schools of thought in entrepreneurship research (adopted from Fayolle, 2002) based on Cunningham and Lischeron (1991)

Entrepreneurial model	**Focus**	**Assumption**
Great person school	Inborn characteristics of entrepreneurs	*Without these inborn characteristics, there is no difference between entrepreneur and any other person*
Psychological characteristics school	Specific and unique psychological traits, values and needs which drive entrepreneurs	*People behave in accordance with their values*
Classical school	Innovation and creativity. Identification of opportunities	*The critical aspect is that the entrepreneurial process is of doing rather than owning*
Management school	Pursuit of business opportunities and the use of appropriate tools to concretise their accomplishment	*Entrepreneurs can be developed and trained in the functions of management*
Leadership school	Leadership qualities of entrepreneurs	*An entrepreneur achieves goals with support of others*
Intrapreneurship school	Entrepreneurship behaviour in existing organisations	*Organisations need to adapt to survive, entrepreneurial activity leads to organisational building*

Based on this characterisation, Cunningham and Lischeron (1991) argue that no one school is superior in explaining the entrepreneurial phenomenon. For example the great person and the psychological school can be used to explain an entrepreneur's values while the classical school can be used to provide insights into the opportunity recognition process. The management and leadership schools can help understand the range of technical and interpersonal skills required to make an operation efficient or to motivate people while the Intrapreneurship School might assist in the process of redirecting efforts.

The choice of the entrepreneurial model depends on the research objective and the research questions and there is need to integrate facets from each dimension if a comprehensive understanding of the entrepreneurship process is required (Fayolle, 2002).

2.6.3. Farm diversification

Maye *et al* (2009) indicate that there are considerable definitional difficulties surrounding farm diversification. The Centre for Rural Research (CRR) defines farm diversification to encompass all additional business activities that are run on the farm or that are dependent on farm-based land and capital assets. It is made up of all economies of scope that the farm business exploits, including agricultural knowledge, capacities of its personnel and equipment (CRR, 2002). For example non-conventional farming activities such as specialist products, food processing, direct marketing, non-farm activities, sports, leisure, accommodation, hire/contracting (Ilbery *et al.* 2006). McNally (2001) defined farm diversification as consisting of the introduction of non-food production enterprises on a farm holding. The key issue appears to be the lack of agreement as to what should be considered as farm diversification and the motivation for the behaviour. Ilbery *et al* (2006) suggest that a clear picture is yet to emerge about why certain farms diversify and others do not.

McElwee (2004) defined diversification as a strategically systemic planned movement away from core activities of the business as a consequence of external pressures, in an effort to remain in and grow the business. The idea that farm diversification involves moving away from core activities (conventional agricultural activities) is also suggested by Ilbery and Bowler (1993) when they argue that diversification does not include any activity that can be considered as conventional agricultural production. Maye *et al* (2009) state however, that activities such as farm-based accommodation and agricultural contracting have been around long enough almost to qualify as being conventional. This is one of the difficulties in finding a definition for farm diversification given the dynamic nature of the phenomenon. Meert *et al* (2005, p.84) suggest a classification framework highlighting the motives for diversification and corresponding types of activity.

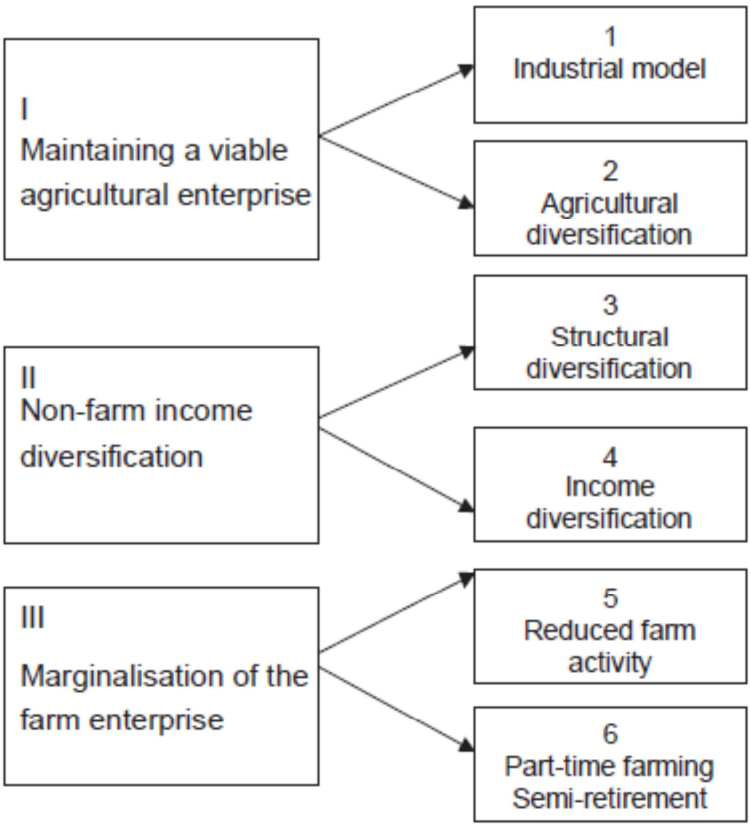


Figure 2.4: Typology of motives for diversification and types of activities
Source: Meert *et al* (2005, p.84)

According to this framework, in *agricultural diversification*, the new activity is still situated in the field of agricultural production and may include the introduction of new and

alternative crops and animals on the farm. The main objective it is argued is to maintained farm business viability. With regards to *structural diversification*, the farm resources are redeployed or restructured into non-agricultural products and services. *Income diversification* involves the use of non-farm household specific resources to non-agricultural or activities unconnected to agriculture. This typically involves off-farm income generating activities. Meert *et al* (2005) suggest that the aims of these types of diversification activities are geared towards obtaining non-farm incomes. The last category of diversification activities can be considered as consisting of exit strategies and consist of the marginalisation of the agricultural enterprise. The classification by Meert *et al* (2005) is broadly similar to those proposed in Ilbery and Bowler (1993), Damianos and Skuras (1996), McNally (2001) and Maye *et al* (2009).

2.6.4. Farm entrepreneurship

Farmers are those who depend partly or fully on a range of activities which are primarily dependent on the farm and by agriculture. Activities which involve soil cultivation, crop and livestock production as main source of income (Vesala *et al.* 2007). The literature on the emerging area of farm entrepreneurship is scarce as calls for research into this area have not led to widespread investigation (McElwee, 2006). It is argued that while there is extensive literature in the separate areas of “farm” and “entrepreneurship”, there is little research that combines these two areas of study (McElwee, 2006). Given the difficulties identified already in obtaining a common definition for entrepreneurship, it is clear that finding one for farm entrepreneurship is bound to be even more complicated.

One issue that has been identified as problematic in finding a definition is that farmers do not involve in activities that are similar to those carried out by those in urban contexts (McElwee, 2008a, McElwee and Annibal, 2010). This statement merits scrutiny as it gives the impression that entrepreneurs are less likely to occur in the farm context. The

suggestion by McElwee is contested by research outcomes from an exploratory survey of 1,000 farm business enterprises in the Cambridgeshire area by Carter and Rosa where they provide evidence of strong similarities between farm and non-farm enterprises (Carter, 1998, Carter 2001, Sara and Rosa, 1998). The authors show that farmers like non-farm businesses have multiple business interests and take part in economic development like other firms do. Carter and Rosa argue that farmers have always been entrepreneurial, are business owner managers and farms can be characterised as businesses. In fact they conclude from the study that the similarities between farm and non-farm businesses are likely to increase over time as a result of policy liberalisation, erosion of traditional markets and the growing cost price squeeze.

In a study of entrepreneurial identity of Finnish 590 small-business owner managers and 2,200 portfolio farmers, Vesala *et al* (2007) contend that farmers possess strong entrepreneurial aspects including personal control, opportunity seeking, risk taking, innovativeness, growth orientation which are quite similar to non-farm entrepreneurs. Based on a segmentation framework of farmer's characteristics, McElwee (2008a) categorises farmers into four groups: the farm as farmer, farmer as entrepreneur, farmer as contractor and rural entrepreneur not farmer[1]. It emerges from this grouping that farmers are a heterogeneous category with some having more entrepreneurial skills than others and so policies which consider farmers as homogenous make serious mistakes.

According to Clark (2009) farm entrepreneurship refers to the creative use by farmers of the diverse local resources and assets rather than "imported" technologies as the basis for alternative activities leading to financial gain. Based on a sample of 118 agricultural enterprises in the UK, Clark (2009) shows that farm entrepreneurs are aware of the

[1]See detailed characteristics of each group in page 473: McElwee, G. (2008a) A taxonomy of entrepreneurial farmers.*International Journal of Entrepreneurship and Small Business*, **6**(3), pp.465-478

regulatory context in which they are embedded and seek to make maximum use of their resources to get information that is of use to them. They are ready to engage in networks and collaborate with others to obtain information or to carry out joint ventures. In Another study of 16 in-depth interviews in Finland, Alsos *et al* (2003) define farm entrepreneurship in line with Stevenson *et al* (1985) as the result of farmers discovering and exploiting opportunities despite their own resources.

Schumpeter (1934) believed that the entrepreneurial endeavour could occur in five cases:

1. The introduction of a new good or a new quality of good;
2. The introduction of a new method of production;
3. The opening of a new market;
4. The conquest of a new source of supply of raw materials; and
5. The carrying out of new organisation or any industry

According to Kizner (1984, p. 52), there are 3 major types of concrete entrepreneurial activity:

1. Arbitrage – consists of acting upon the discovery of a present discrepancy (net of all delivery) between prices at which a given product can be bought and sold. The discovery refers to a pure opportunity for profit. Arbitrage calls for no innovation and no risk bearing because buying and selling takes place simultaneously;
2. Speculative activity – which is arbitrage over time: It is engaged by an entrepreneur who believes that he or she has discovered a discrepancy between the prices at which a given item can be bought today and sold in the future. The incentive is the expected gain to be derived from selling the product at a future price. Such an activity entails risk bearing but not necessarily innovation;

3. Innovative activity consists in the creation of an output, method of production, or organisation not hitherto in use. For such an activity to be profitable, it must display the price discrepancy observed in the speculative activity.

Looking at farm entrepreneurship, Clark (2009, p.218) suggests that:

> On-farm entrepreneurial characteristics might therefore include the following.
>
> (1) *Novel redeployment of the bases of agricultural production*: redeployment of land, labour and capital by farmers to increase competitiveness (e.g. renting out of buildings for alternative uses); and/or to increase business income; and/or sustain employment, and/or generate new employment.
> (2) *The adoption of a new market orientation*: practices, products and processes that increase business viability by addressing local, regional, national and/or global demand, and/or which improve access to commercial outlets (e.g. *vente directe*/farmers' markets; niche products, including organic; greater emphasis on 'quality'; greater demand for seasonality).
> (3) *Capitalizing on endogenous resources*: practices, products, and processes which utilize and/or are based upon territorial identity or image, and/or that mobilize local community resources; which reconnect 'product with place'.
> (4) *New forms of governance*: the adoption of a collective, rather than an independent approach to solving business management problems (e.g. machinery rings; co-operative structures, etc.) (Boekhoelt 1998).
> (5) *Community involvement/support*: active support for new business ventures from local communities, possibly in the form of partnerships (e.g. 'community supported agriculture', Pretty 1998).
> (6) *Management of space and natural resources*: practices, products and processes which decrease/lessen reliance upon fossil fuels, and/or that provide active environmental management of land.

Source: Clark (2009, p.218)

In view of categorisation proposed by Clark, Schumpeter and Kizner above, investment in RE is considered as an entrepreneurial activity as it involves management of space and natural resources and often requires redeployment of the basis of agricultural production. Sherrington and Moran (2010) suggest in effect that RE production on farms can be considered as a novel enterprise. Additionally, RE production and related enterprises are risky businesses and operate in largely immature markets and uncertain environments, and the resources required for investment are often beyond the control of a single investor (Masini and Menichetti, 2012, Wüstenhagen and Menichetti, 2012).

In order to avoid the discrepancies in the definitions of entrepreneurship/entrepreneur, Shapero (1984, p. 23) suggests the entrepreneurial event as unit of analysis because it allows a large range of entrepreneurial activities to be considered without having to be tied to the features of any particular kind of individual – one time entrepreneur, part time entrepreneur as well as the repetitive entrepreneur. Entrepreneurial events can consist of a number of dimensions:

1. *Initiative taking* – an individual or group takes the initiative;
2. *Bringing resources together* in organisational form to accomplish some objective or reorganising the resources in an existing organisation;
3. *Management*- of the organisation by those who took the initiative;
4. *Relative autonomy*- relative freedom to dispose of and distribute resources; and
5. *Risk taking*- the organisation's success or failure is shared by the initiators/managers.

For Shapero (1984) in seeking explanations of entrepreneurial phenomena, the event becomes the dependent variable while the individuals or groups that generate the event become the independent variables as do the social, political, cultural and situational factors affecting venture formation. In view of these discussions, past farm entrepreneurship research has argued that farmers have always been entrepreneurial and so researchers should apply the methods used in analysing business in other sectors to rural enterprises such as farms (Carter, 1998, McNally, 2001, Alsos *et al.* 2003, Alsos and Carter, 2006). Others have argued that because entrepreneurship is still in its early stages of development, most of the studies thus far have borrowed its methods from other fields of study (Bull and Willard, 1993). Very recently rural entrepreneurship researchers have called for caution when they argue that:

> ‘the relationship between the farmer and the farm business is a complex issue, as the farmer can be an owner, a tenant, a manager, a sub-contractor or a combination, suggesting that the methods used to analyse business entrepreneurs in other sectors may not be easily transferred to an analysis of farms and farmers’ (McElwee and Annibal, 2010, p. 477).

The difficulty to obtain a common definition of what farm based entrepreneurship is, has led some to suggest that in any case some farmers will have more entrepreneurial propensity and capabilities than others (McElwee and Annibal, 2010). If farmers have always been entrepreneurial as Carter argues, then they should have the necessary skills and capacities required for entrepreneurship, if not then they need to acquire the necessary abilities and capacities it is argued (McElwee, 2005, McElwee and Baxter, 2005). Does it mean that individuals who are entrepreneurial always have all the skills they need? McElwee and Bosworth (2010) argue that the case is more likely to apply to small farmers as they have traditionally been protected through income support from the CAP and hence have not been involved in any competitive business activities. Additionally, it is argued that small farmers do not have the management and leadership skills characteristic of large business corporations or larger farm businesses. Pyysiainen *et al* (2006) stress the need to distinguish between role/managerial skills required to set up and run a business and entrepreneurial skills. A key challenge for the farm sector though is to enable farmers to develop entrepreneurial skills in view of the numerous challenges faced by them (Vesala *et al.* 2007). While there is increasing interest in farmers’ entrepreneurial skills (McElwee, 2005, McElwee and Baxter, 2005, McElwee, 2006, McElwee, 2008b, Morgan *et al.* 2010, Rudman, 2008, Vesala and Pyysiäinen, 2008), there are arguments that farm entrepreneurship can be comprehensively understood by also taking into consideration the attitudes and motivations of farmers within a changing environmental context (Pyysiainen *et al.* 2006).

2.7. Theoretical foundations and model development for the study

> 'A theory is defined as a set of interrelated constructs, definitions and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting the phenomena' (Bull and Willard, 1993, p.187 adopted from, Kerlinger (1973, p.9).

At the outset of this research, one of the main concerns was to find out the main issues surrounding the role/potential role of the farm sector with regards to meeting the country's climate change, energy and agricultural policy objectives through investment in RE ventures. There was concern about the low level of interest in these ventures and the question was to find out why some farmers have a go at it why others do not. From an entrepreneurship perspective, the literature found that there were a number of perspectives to understand the phenomenon. According to Baron (2004, p.170) the

> 'entrepreneurial process is very complex, and is influenced by a multitude of variables operating at three distinct levels: **the individual level** (the motives, skills, and cognitive processes of individual entrepreneurs), **the interpersonal level** (relationships between entrepreneurs and other persons), and **the societal level** (e.g., government politics, economic and market conditions, etc.)'.

Most studies of entrepreneurship fall in to one of these three areas (1) focusing on the individual (entrepreneur – demographics, personality, psychological traits, cognitions); the environment (wide range of social, political, economic and cultural factors) or the organisation (tangible and non-tangible resources). Until now research tends to focus on one of the three approaches to new venture creation and very little empirical study including all three approaches has been carried out (Rotefoss and Kolvereid, 2005). This view is shared by Zhao *et al* (2005, p. 1265) that:

> 'despite decades of research, scholars currently have only a limited understanding of the factors and decision processes that lead an individual to become an entrepreneur. Previous research in this area has tended to lack a strong theoretical orientation; variables have been examined in isolation and have sometimes been included with no clear theoretical rationale. This approach has resulted in an extensive list of possible antecedents but few consistent findings leading to doubt that individual-level antecedents of entrepreneurship can ever be found'.

This study adopts a holistic approach to consider all the three major areas of study affecting new venture creation. The following review considers how each of these perspectives helps our understanding of the factors affecting farmers' decisions to start new RE ventures.

In the first instance, a resource based view (of the farm and of the farmer) is adopted which emphasises the role of structural and demographic factors as critical determinants of new activity creation (Walley *et al.* 2011, Alsos *et al.* 2003). The second theoretical foundation is derived from cognition based theories of behaviour which place the individual (farmer) at the centre of the venture creation process. These cognitive based models are from the TPB (Azjen, 1991), SEE model (Shapero and Sokol, 1982) and its subsequent updates (Krueger Jr and Brazeal, 1994, Krueger, 1993, Krueger *et al.* 2000) and the SCT (Bandura 1977, Bandura, 1989, Bandura, 1999). Finally, on the environmental factors affecting entrepreneurship, the thesis draws from institutional theory (Bowen and De Clercq, 2007, Dacin *et al.* 2002, Scott, 1995, Scott, 2008, North, 1990) and specifically from the concept of country institutional profile (Kostova 1997, Busenitz *et al.* 2000).

This section is organised into three sub sections. The first sub section takes a resource base view. The relevant literature helps to clarify the role of structural and demographic factors which may influence the creation of a new enterprise on farms more specifically. The second sub section presents literature which places the individual at the centre of the decision making process. The TPB, SEE models and the SCT provide understanding of the potential influence of individual perceptual cognitions on entrepreneurship. Finally, the third sub section derives from institutional theory and discusses the potential influence of regulatory, cognitive and normative institutions on entrepreneurship. The literature review ends with the development of a refined conceptual framework which pushes forward RE and entrepreneurship research and provides the basis for continuation of the study.

The first sub section starts with the review of literature which focuses on the influence of the business resources on the decision to start a new activity.

2.7.1. The influence of the farm/farmer business resource base on new venture creation

The resource based theory (RBT) was developed by strategic management theorists (Wernerfelt, 1995) to understand firm competitive advantage, but has also being applied to entrepreneurship research (Alvarez and Busenitz, 2001, Peng, 2001, Peng *et al.* 2009, Alsos *et al.* 2003). The application of the RBT to farm diversification has been limited though (Alsos *et al.* 2003, Walley *et al.* 2011). Proponents of this theory argue that it is the only one in strategic management that can help explain different kinds of organisational diversification activities (Wernerfelt, 1995, Ray *et al.* 2004) and as such it provides a useful framework for studying farm entrepreneurship (Walley *et al.* 2011, Alsos *et al.* 2003).

According to Wernerfelt a "resource is anything which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi permanently to the firm (Wernerfelt, 1984, p.172). Resource heterogeneity is the basic condition of the resource based theory of the firm. It assumes that some bundles of organisational resources and capabilities required for production of goods and services are heterogeneous across firms (Alvarez and Busenitz, 2001). Competitive advantage, it is argued, derives from these resources which have to be valuable, rare, and difficult to imitate and have very little substitutes otherwise the firm cannot outsmart competitors in the market place. Profitability of the firm is considered dependent on the influence of the size, magnitude and nature of the firms' resources and opportunities (Irwin *et al.* 1998).

A firm's resource can also be understood as consisting of productive resources and management (intangible) resources (Hansen *et al*. 2004). These authors argue that what distinguishes farmers in the same region having access to the same resources and markets will be the intangible resources. The authors contend that it is the specificity of the human resource that explains why some farmers will go bust while others with very similar productive resources grow, expand and survive. This view is supported by the capability building view which suggests that rents are created in the firm as a consequence of the firms acquired abilities to make use of its resources (Makadok, 2001). The personal experience, knowledge, education, and training are the human resources/intangible resources which business founders bring to the enterprise (Rotefoss and Kolvereid, 2005).

Alvarez and Busenitz suggest that these intangible resources may be truly idiosyncratic assets which help a firm to stand out from others (Alvarez and Busenitz, 2001). For example, an entrepreneurial cognition which recognises and helps generate new opportunities, builds relationships and networks with individuals and other firms and facilitates the mobilisation of external resources required for firm growth. Walley *et al* (2011) consider the tacit knowledge of individuals as the most important strategic resource because it is unique, non tradable and may be enhanced over time. Despite the important role of the intangible resources, they argue that the success of a diversification activity actually depends on a healthy mix of both tangible and intangible resources. Based on a survey of 3,000 farmers from across the East Midlands and Yorkshire and Humber government areas of the UK, McElwee and Bosworth (2010) put forward the view that the success of farm diversification is dependent on the farmer's personal situation, the farm business characteristics, as well as the farmer's managerial and entrepreneurial skills.

Large firms are often considered to have competitive advantage due to economies of scale. They are better able to take advantage of markets and population growth ploughing back

their incomes into advertising, research and development, add more product lines and access long term long loans. They are better able to deal with duress as opposed to small sized firms it is argued (White, 1976). Others argue that it is not about the size or resources themselves, but what the resources are used for that creates competitive advantage. In this way firms that fail to effectively and efficiently allocate their resources cannot expect to have competitive advantage from their resources (Ray *et al.* 2004). The authors however agree with the fact that firms are not empty canvasses and therefore firms with limited resources and capabilities will be constrained from carrying out certain activities. Resources, however, can also be mobilised from public or private organisations (Flynn, 1993).

The RBV thus provides a framework to understand differences in the performance of firms on the grounds of their resource endowments. In the case of farmers, it can be hypothesised that farmers with better resource endowments will be better able to exploit market opportunities, create rents, grow and expand. Also, firms with better administrative resources will outperform other firms with similar physical resources. A number of studies have applied the RBV to farm entrepreneurship research. A few important ones are discussed below.

In a study of Norwegian farmers, Alsos *et al* (2003) show that resource exploiting entrepreneurs are motivated by the wish to utilise unique resources or to recombine their resources in innovative ways. They provide evidence to the fact that human capital resources resulting from education or work experience offer opportunities to start new business activities. Portfolio entrepreneurship in the UK farm sector was subject of another study by Carter (1998). In the study, the farmer's personal characteristics and the farm business situation were reported as important determinants of entrepreneurship. She found evidence illustrating the fact that well trained, experienced and younger farmers were more

likely to be structural diversifiers or portfolio owners. Additionally, structural and portfolio owners were more likely to operate as partnerships, limited companies, have larger farms with high agricultural sales. In such situations, a farm's resource endowment gave access to raw materials, facilitated the use of resources such as buildings, distribution channels and networks for the new and former business activities.

Studying entrepreneurship and diversification, Clark (2009) found that diversification was a common feature in a sample of 118 agricultural enterprises in the UK. Findings showed that the addition of new enterprises on the farm was determined by access to networks of professionals or informal contacts. Bowler *et al* (1996) studied the development of alternative farm enterprises (AFE) in the Northern Pennines (Durham and Northumberland) of England and suggested that factors affecting the decision to add an additional business on the farm could be summarised into two main categories: internal and external.

For the internal factors, main motivations to start an AFE was the desire to maintain or increase income generated from the farm business (63%), react to a market opportunity (22%), valorise underexploited farm resources (22%) create employment. Amongst the external stimuli reported (the availability of markets, government grants), the adoption of a state grant was relatively unimportant as a stimulus to the development of an AFE. Ilbery *et al* (2006) and Maye *et al* (2009) carried out a nationwide study of diversification on tenant farms in the UK. Results from this study, showed that structural factors such as farm size and type, pressure on farm incomes, characteristics of those running the farm, and family life cycle were significant determinants of new activity creation on the farms in addition to the favourability of the policy environment, market opportunities and location of the farm business. Additionally, the type of tenure did not appear to have a significant impact on the decision to diversify though tenanted farms were the least likely to diversify.

The authors raised the concern that decoupling of subsidies from agriculture could potentially make it more difficult for tenant farmers to respond to market realities.

Evans (2009) analysed data collected in Herefordshire and Shropshire Counties between 2000 and 2003 to study farm adjustment strategies[2] in the Welsh Marches. Survey and case study results show that farm business diversification is motivated by the need for extra income, good location, personal use/interest, identification of a market and lack of agricultural alternatives. Other researchers have also established relationships between the farming systems and the desire to engage in additional business activities. For example, farmers involved in arable based farms had higher chances of engaging in farm diversification than dairy farms, reason being that dairy activities were all year round and prevented farmers from wanting to take up additional businesses.

The decision making processes of Russian farmers was subject of a study by Bokusheva *et al* (2007). They found that diversification was affected by the level of perceived uncertainty in the farming activity and the farm's level of technological endowment at the beginning of the process. Also, investment decisions were strongly determined by the farmer's managerial capacities, age, ownership structure and farm size and more importantly the need for economic survival (Bokusheva *et al.* 2007).

There are also specific barriers to new enterprise creation of farms: lack of management skills, lack of entrepreneurial spirit, regulation, limited access to business support, tenancy agreements (McElwee, 2005), attitudes towards risk, additional labour requirements, yields, start-up costs (Windle and Rolfe, 2005) and age (Anosike and Coughenour, 1990).

[2]Elements of farm adjustment suggested by Munton (1990): farm enterprise, labour, business structure, tenure, size, economic centrality and diversification.

There is also a stream of research into the adoption of RE production and related enterprises that is based on the influence of the farm business resource base and farmers' willingness to invest in a wide range of RE ventures. A few significant ones are discussed in the next section.

In a study of Swedish farmers, researchers established that farmers on large estates of between 30 and 60 ha were more likely to grow willows than other farmers with lower farm sizes. It appeared that larger farm enterprises were better able to assess risks and to diversify, tended to be better informed about the economy and subsidies. Food crops, vegetable farms and irrigated systems correlated positively with likelihood to grow willows contrary to milk production and cattle enterprises which indicated negative relationships (Rosenqvist *et al.* 2000). Other research in Sweden identified a negative relationship between livestock farming systems and adoption of willow in Sweden. Other factors like farm size and access to financial resources were found to be positively related to farmers' willingness to plant biomass crops (Mola-Yudego and Pelkonen, 2008).

The willingness of farmers in the United States was subject of a study in 2007 (Jensen *et al.* 2007). The study reported a negative relationship between farmers' willingness to invest in RE crops and age. Other results indicated that insecure land tenure reduced the tendency to grow perennial crops, higher farm incomes were positively related to willingness to invest in energy crops but that net farm incomes per hectare represented an opportunity cost which reduced the propensity to grow while there was a net negative relationship of livestock farms revealing a high opportunity cost of converting pasture land. In addition, younger farmers and persons with higher levels of education showed more interest to grow energy crops.

Results of this kind have also been reported in a study focused on the adoption of anaerobic digestion enterprises in the UK farm sector (Tranter *et al.* 2011). Similar studies on the adoption of energy crops in Ireland show that growing cereal crops and having a higher level of education is related farmers' willingness to invest in bioenergy crops. Interestingly, the role of successors is reported to have a large marginal effect on investment intentions while the market gross margin per hectare of energy crops has insignificant influence on intentions meaning that the decision to adopt is not driven by financial considerations (Clancy *et al.* 2008, Rosenqvist and Dawson, 2005, Clancy *et al.* 2011).

Recent research in Scotland shows that a majority of farmers consider it difficult to estimate returns from the production of bioenergy crops due to uncertainty of costs, prices and yields. Lack of clarity amongst established farmers was reported to affect investment intentions negatively (Sherrington, Bartley and Moran, 2008). Other research in France on the adoption of Miscanthus and Switch by farmers in the Eure-et-Loir department concluded that the production of these energy crops was found to be less profitable than the production of traditional crops (Bocqueho and Jacquet, 2010). Similar results about financial viability of bioenergy crop production have been reported in Sweden by Roos and Rakos (2000), Rosenqvist and Dawson (2005), Rosenqvist *et al* (2000) and Sherrington and Moran (2010) in the UK.

Other enterprises, such as solar, seem to offer flexibility to the farmers as they may not directly compete with other traditional agricultural activities for land. Recent evidence in Wales suggests that farmers may be willing to lease out portions of their land for wind development. Where such lease arrangements are possible, farmers may take part in joint ventures by contributing land for wind farm development (Munday *et al.* 2010).

Based on the findings of Bokusheva and others, it emerges that farmers will differ in their ability and incentive to start new enterprises because as McNally (2001) puts it, farmers who have accumulated assets and resources over time are in a better position to take advantage of market opportunities. Ilbery *et al* (2006) argue that despite understanding that factors such as farm size and type, characteristics of those who run the farms, market opportunities, policy may be influential in the decision to diversify, a clear picture is yet to emerge about why certain farmers diversify and others do not. Given that diversification is not always successful, research into the phenomenon is needed in order to enhance success rates (Walley *et al.* 2011).

A key weakness identified in the resource based approach when applied to the farm entrepreneurship is that the role played by the individual's own ideas and intentions is overlooked (Alsos *et al.* 2003). In a study of farmers' participation in agri-environmental schemes in the UK, research outcomes show that farmers impose their attitudinal intentions on their firm circumstances and that these intentions determine the outcomes (Battershill and Gilg, 1996). These observations had been made earlier by Munton and Marsden in their study of occupational land change in the UK when they called for better understanding of the farmers' attitudinal influences on their decisions to restructure (Munton and Marsden, 1991).

Other researchers have also criticised this view for overlooking the farmer focus and failing to account for behavioural/psychological factors as it ignores the role of the farmers' perspective and attitudes in decision making processes either involving the creation of new enterprises (Austin *et al.* 1998, Willock *et al.* 1999, Burton *et al.* 1999, Burton and Wilson, 2006, Bergevoet *et al.* 2004), taking part in environmental schemes (Morris and Potter, 1995, Wilson, 1996) or accessing financial support (Holloway and Ilbery, 1995, Ilbery *et al.* 2009). Despite these calls to integrate the investor's perspective

in the investment decision making process, researchers point out that there continues to be limited understanding of the role of psychological and behavioural factors in the RE investment decision making process (Huijts *et al.* 2012, Masini and Menichetti, 2012, Wilson 1996).

2.7.2. Cognitive theory based foundations of the thesis

According to Burton (2004) socio-behavioural approaches in agricultural studies are those that:

(i) Seek to understand the behaviour of individual decision makers, usually the farmer or land manager directly responsible for the land;

(ii) Focus on psychological constructs such as attitudes, values, goals but also collects data on economic and demographic factors; and

(iii) Employ largely quantitative methodologies in particular the use of psychometric scales such as Likert-scales.

According to Burton (2006), the development in social psychology of the theory of reasoned action (TRA) (Azjen and Fishbein, 1973) was the starting point for the introduction of behavioural approaches in agricultural studies especially as the approach was reliably able to demonstrate a relationship between attitudes and behaviour. To date, the successor of the TRA, the TPB remains a dominant theoretical framework used in agricultural research to study farmer behaviour (Jones, 2006). Jones argues that this is mainly because the measurement and analysis of attitudes is straightforward and requires the use of standardised survey techniques and quantitative methodologies. In addition, the simplicity of the results from attitudinal studies renders them useful within contract research because of the need for easy, standardised and replicable studies.

2.7.2.1. The Theory of Planned Behaviour

The TPB emanated from the theory of reasoned action (TRA) as a socio-psychological/cognitive model (figure 2.5). The TRA was designed to deal with the prediction of specific behavioural intentions in well-defined situations (Azjen and Fishbein, 1973). The TRA assumed that most behaviour was under volitional control of individuals and that in a given situation an individual will hold or form a specific intention that will influence future behaviour. The theory showed that when properly measured, behavioural intentions are highly predictive of actual behaviour.

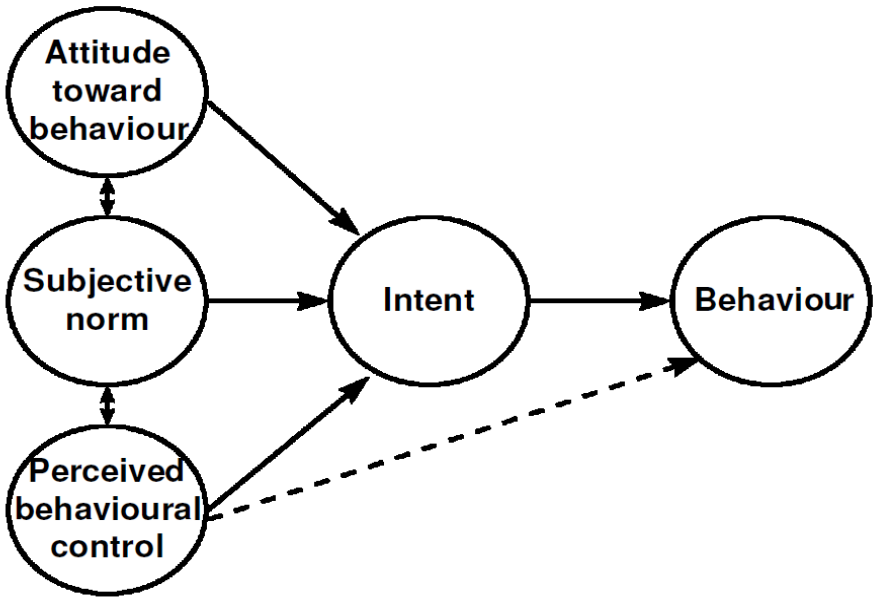


Figure 2.5: The Theory of Planned Behaviour
Source: Azjen (1991)

2.7.2.1.1. Intention – Behaviour Relationship in Entrepreneurship

Entrepreneurship is a process where intentionality is central (Krueger, 1993). Entrepreneurial intentions refer to the intention of an individual to set up a new venture at some point in the future (Fitzsimmons and Douglas, 2010). They represent the state of the mind that directs and guides actions of the entrepreneur towards the development and implementation of a business concept (Boyd and Vozikis, 1994). According to Bird

(1988), intentions focus a person's attitudes, experience and behaviour towards a specific object or method of behaving and therefore serve as a perceptual screen for viewing relationships, resources and exchanges. They provide an indication of how hard people are willing to try, or how much effort they are planning to exert, in order to perform the behaviour (Azjen and Fishbein, 1973, Azjen, 1991). This is because intentions are assumed to capture the motivational factors that influence behaviour (Wiklund and Shepherd, 2003). Azjen (1991) posits that individuals are likely to engage in a specific behaviour when intentions towards the act are strong.

Douglas and Fitzsimmons (2005, p.937) argue that:

> 'if we can identify and predict the antecedents of entrepreneurial behaviour, then governments would be able to focus attention and resources on those individuals who are most likely to form entrepreneurial intentions and subsequently engage in entrepreneurial behaviour'.

In this study, entrepreneurial intentions refer to the intention of a farmer to invest in RE production and associated enterprises in the near future. As Douglas and Fitzsimmons (2005) propose, there is much understanding of the antecedents of entrepreneurial intentions amongst potential entrepreneurs but little is known about the antecedents of intentions within business. This research fills this research gap as it aims to evaluate the factors which influence intentions within the farm business. The thesis does not investigate the relationship between intentions and behaviour but relies on past research that has established that intention is the best single predictor of behaviour (Azjen and Fishbein, 1973, Azjen, 1991). The theory acknowledges the possibility that behavioural intentions might change after they have been measured or even before the behaviour has been observed. New information about behavioural consequences and or normative expectations could also produce changes and therefore reduce the chances that behavioural intentions will lead to overt behaviour.

2.7.2.1.2. The influence of attitudes and subjective norms on intentions

In the TPB model, behavioural intentions are determined by three factors (Azjen, 1991). The first is the person's attitude towards behaviour and refers to the extent to which a person has a favourable or unfavourable evaluation of appraisal of the behaviour in question (value expectancy model). The second predictor refers to the subjective norms. This factor refers to the perceived social pressure to perform or not to perform an act. It deals with the influence of social environment on behaviour and represents the actor's belief about the likelihood that members of a given reference group expect him/her to perform the behaviour in question as well as the individual's motivation to comply with the reference group's expectations. The third antecedent of intentions is the degree of perceived behavioural control (PBC) which refers to the ease or difficulty of performing the behaviour and is assumed to reflect past experience as well as anticipated impediments and obstacles. The general rule is that the more favourable the attitude and subjective norm with respect to the behaviour; the stronger should be the intentions to perform the behaviour under consideration.

2.7.2.1.3. The inclusion of Perceived Behavioural Control to the TRA

The TPB was developed to improve on the TRA (Azjen, 1991) to be able to deal with behaviours that are not under the volitional control of individuals as assumed in the TRA. The TPB acknowledges that in reality the performance of most behaviour depends at least to some extent on the availability of opportunities and resources which are not controlled by an individual/entity. Given the weakness of the TRA to deal with this issue, Azjen introduced the "perceived behavioural control" construct. PBC refers to people's perception of the ease or difficulty of performing the behaviour of interest. PBC is concerned with judgements of people's level of confidence in their ability to perform specific actions. Since its development, the TPB has been very instrumental in agricultural

research with focus on adoption of new technologies (Wauters *et al.* 2010, Burton, 2004, Burton and Wilson, 2006, Beedell and Rehman, 1996, Beedell and Rehman, 1999, Beedell and Rehman, 2000, Jones, 2006). The application of behavioural approaches to RE adoption/investment research is relatively recent (Segon *et al.* 2004, Mattison and Norris, 2007, Huijts *et al.* 2012, Masini and Menichetti, 2012, Sherrington and Moran, 2007).

Though the recent works of Huijts and others are not based on the TPB, they are a continuous reminder that the role of the farmer/investor is critical in all research that is geared towards improving the uptake of RE production and associated enterprises in the EU (Huijts *et al.* 2012, Masini and Menichetti, 2012). Discussions in this section point to the relevance and usefulness of socio-psychological approaches that place the farmer at the centre of the decision making process. Such an approach should help provide better understanding of investment decision making across a wide range of areas.

2.7.2.2. Shapero's Entrepreneurship Event (SEE)

One other perceptual cognitive model used in this study is that developed by Shapero and Sokol (1982) and Shapero (1984) which emphasises the central role of perceived, enacted reality. The view that potential entrepreneurs enact an environment that appears favourable. The SEE model is built on two main blocks: displacement events in one's life path and credibility of an act (perceptions of its feasibility and desirability) as shown in figure 2.6.

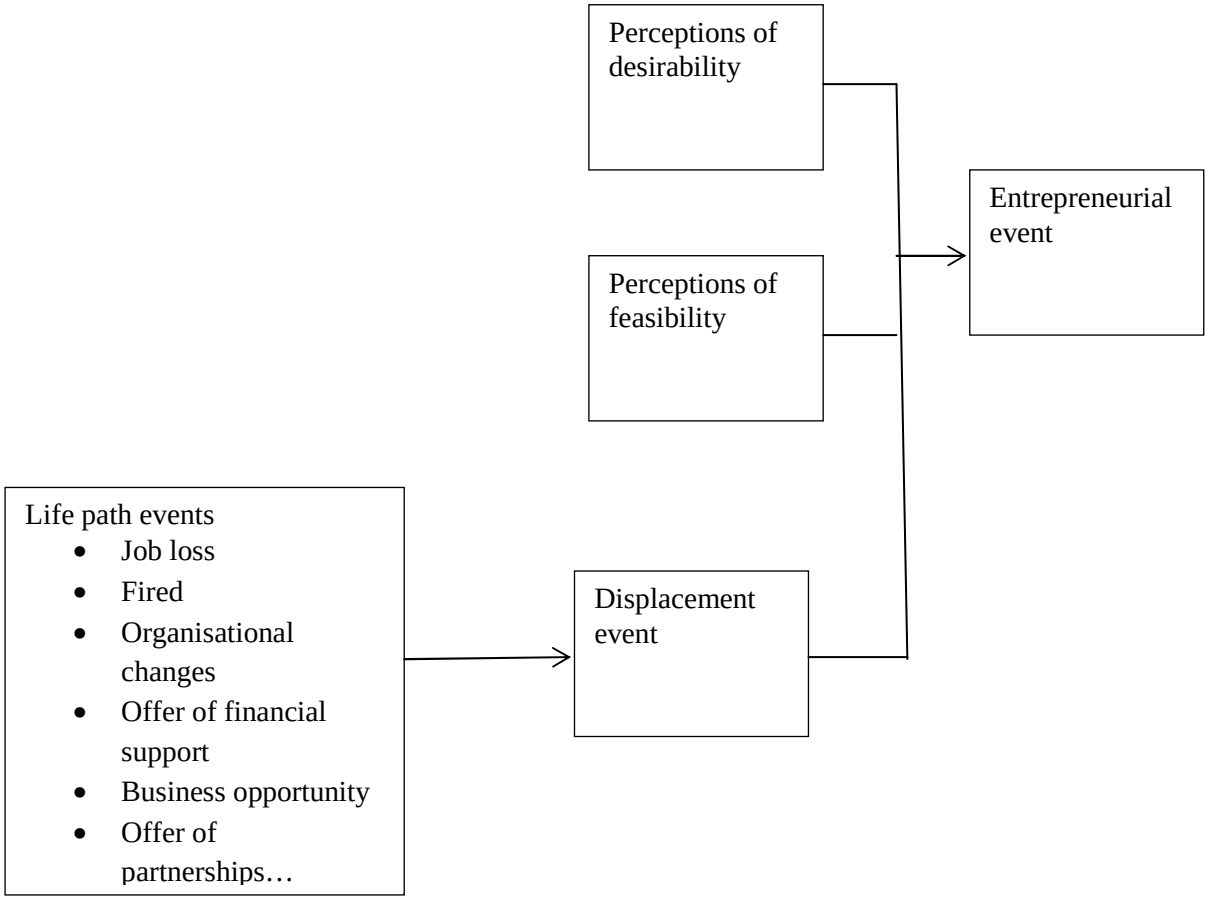


Figure 2.6: Shapero and Sokol Entrepreneurial Event Model

2.7.2.2.1. Displacement events

According to the SEE model, a displacement event serves as a stimulus or catalyst for a change in behaviour. This event pushes an individual to react to the situation by assessing credibility of the new behaviour. According to the model, individuals should first of all perceive the new behaviour as being credible (there should be intentions towards the act as well as the availability of opportunities) and the individual must perceive the venture as personally feasible and desirable. In the case of employment, displacement events are positive or negative situations that initiate thoughts of venture creation (e.g. job loss, dissatisfaction...). Displacement events or catalysts for change in agriculture are discussed below.

Pressures introduced by the CAP reform on agricultural enterprises in the UK have been documented (Slee, 1987). These pressures continue to increase with decreasing financial farm support and the need for agriculture to restructure and conform to international trade standards (Argiles, 2001). Other challenges in the agricultural sector since the mid 1990s have been the incidence of animal health issues notably Bovine Spongiform Encephalopathy (BSE), the foot and mouth outbreaks and the occurrence of *E. coli*, unstable markets and dwindling public sector support (Convery *et al.* 2012, Nix, 2012). Within the UK, a combination of these factors including movements in exchange rates, falling world prices and continuing reform of the CAP have eroded incomes from agriculture and accentuated that cost-price squeeze (Lobley and Potter, 2004, Ilbery *et al.*2006). In addition to these pressures, climate change, rising fuel costs, and changes in supply chain and consumer demands place additional pressures on farmers (de Wolf and Schoorlemmer, 2008). High volatility and variability of agricultural incomes has been a major source of risk to farm businesses (Buffier and Metternick-Jones, 1995) and has made business survival difficult to achieve (Gifford, 2003). In line with decline in the agricultural sector (Argiles, 2001) and increasing pressures to restructure, a stronger entrepreneurial orientation has been suggested as a possible solution (Alsos *et al.* 2003, McElwee, 2005, McElwee and Baxter, 2005) and farm based entrepreneurship is promoted as an integral part of EU agricultural policies (Clark, 2009, Vesala *et al.* 2007).

2.7.2.2.2. Perceived feasibility

Perceived feasibility refers to the degree to which a person beliefs in their abilities to start a business (Shapero and Sokol, 1982). Research has emphasised the importance of perceptions as opposed to objective values in the study of venture creation processes (Chen *et al.* 1998, Edelman and Yli-Renko, 2010, Lim *et al.* 2010, Shane, 2000, Zhao *et al.* 2005).

Ability expectations or perceptions play a significant role in influencing decisions to start a venture (Townsend *et al.* 2010) and earlier studies have established positive relationships between self-efficacy perceptions and intentions to start a business (Bandura 1977, Boyd and Vozikis, 1994, Chen *et al.* 1998, Hao *et al.* 2005, Krueger *et al.* 2000, McGee *et al.* 2009, Trevelyan, 2009). Self-efficacy as a measure of perceived feasibility determines both the strength of entrepreneurial intentions and the likelihood that those intentions will result in entrepreneurial actions (Boyd and Vozikis, 1994). Self-efficacy, commitment and confidence distinguish those who engage in, and persist in actions from those who do not (Trevelyan, 2009). That is individuals are more inclined to engage in entrepreneurial activities when they belief they have the necessary skills required to operate in that environment (DeNoble *et al.* 1999).

Within the context of farm entrepreneurship, Vesala *et al* (2007, p.51) argue that:

> 'effective diversification or plurality does not specifically depend on the farm's external environment and the threats and opportunities, which that environment offers; to diversify farmers need to be externally aware and have the capability to do so'.

This research argues that farmers with high perceptions of self-efficacy are more likely to invest in RE production and associated enterprises than those with low self-efficacy.

2.7.2.2.3. Perceived desirability

Shapero (1975) suggest that in order to undertake an enterprise that is new, the act must be seen as credible – desirable and feasible. According to Shapero (1982, p.25) perceptions of desirability have to do with values – values defined as a concept of the desirable. Shapero and Sokol defined perceived desirability of a venture as the degree to which one found the prospect of starting a new business attractive (Shapero and Sokol, 1982). They argue that perceptions of what is desirable are the result of our placement in a matrix of culture, socio

economic structure, family, education, peers and influential persons. Linked to the concept of desirability, is that of opportunity. Opportunities are sets of subjective expectations of what entrepreneurs think can be accomplished (Edelman and Yli-Renko, 2010). These may refer to the value to be gained from investing in specific activities. This value added can be economic returns and or social contribution to the entrepreneur's efforts (Mitchell *et al*. 2010). For farmer the question would be – what is in this for me? What is the potential contribution of the RE enterprise to overall farm business viability considering the existing enterprise mix. It is argued that where farmers consider that there are opportunities and potential value added to be obtained from RE enterprises, that the more likely they will consider investment.

The SEE model has been proven to be robust with respect to the prediction of entrepreneurial intentions in many instances (Krueger, 1993, Krueger *et al.* 2000, Krueger and Brazeal, 1994). Krueger (1993) tested the model in a sample of 126 students. Intentions were operationalised as dichotomous variables, principal component analysis as well as path analysis techniques were used to test the intentions based model. It emerged from the analysis that perceived feasibility and desirability were directly related to intentions to start a business. The study also revealed that exogenous factors influenced intentions through attitudes. Krueger suggested the need to include other exogenous factors into the intentions model and to refine the definition of constructs having identified for example that intentions were best measured as a continuum rather than using dichotomous variables. In yet another exercise, Krueger and Brazeal (1994) suggested the importance of community support in the development of positive attitudes towards an act. They furthered the operational definitions of the SEE constructs by suggesting for example that perceived desirability of an act should be measured by not only focusing on perceived extrinsic benefits but take into consideration, the possible intrinsic benefits that could be obtained from starting the venture.

2.7.2.2.4. Possibility of interaction effects between perceived feasibility and desirability

The Shapero and Sokol (1982) SEE model suggests that in the process of venture creation, an individual first of all asks whether it is desirable to carry out the act before evaluating feasibility. Krueger (1993) and Krueger and Brazeal (1994) argue that the questions about feasibility and desirability are asked simultaneously rather than sequentially as argued by Shapero. A number of studies illustrate that in effect, decision making is a complex process and it is likely that interaction effects exist amongst the factors to influence a specific decision (Mitchell and Shepherd, 2010). An earlier attempt to establish the existence of interaction effects did not succeed to do so (Krueger, 1993). Krueger argued that this could have resulted from poor operationalisation of the dependent variable in the study (single item dichotomous measure for entrepreneurial intentions). Two very recent studies have not brought this discussion to a close because of divergent results. In the first study, Townsend *et al* (2010) did not find any significant interaction effects between perceived feasibility and desirability on entrepreneurial activity while Fitzsimmons and Douglas (2010) found a significant negative interaction effect. What emerges is that research on the possibility of interaction effects is inconclusive and there is need for further investigation.

2.7.2.3. Social Cognition Theory

Social cognition theory (SCT) emerged from social learning theory and provides a framework to explain and predict human behaviour. It explains human behaviour as the result of the interaction between an individual and the environment (Bandura, 1977, Bandura, 1989). In this theory, individuals make causal contribution to their motivation and action within a system of triadic reciprocal causation (Bandura, 1989 see figure 2.7 below). For this reason, Bandura argues that any account of the determinants of human action must include self- generated influences on the contributing factors.

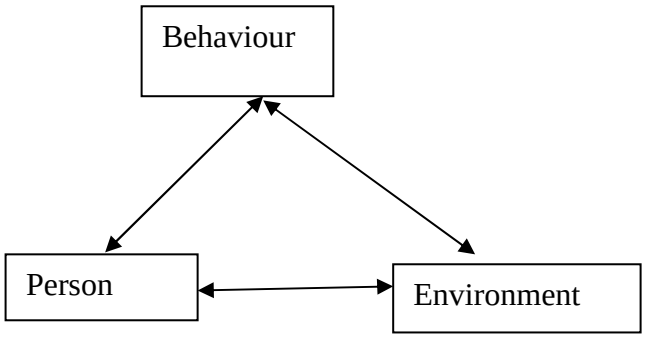


Figure 2.7: Triadic interaction between person, environment and behaviour
Source: developed from Bandura (1989, p.1175)

Bandura argued earlier (1977) that in this interaction; cognitive processes/events mediate the change in behaviour. These cognitive events include perceived ability and outcome expectancies. Bandura defined outcome expectancies as a person's estimate that a given behaviour will lead to certain outcomes while ability expectancies referred to peoples' judgements of their capabilities to organise and execute courses of action required to attain designated types of performance. According to Bandura (1989), SCT is not concerned with the skills one has, but with the judgements of what can be done with whatever skills one possesses. Ability expectancies or self-efficacy is central in influencing behaviour and determine whether behaviour will be initiated, how much effort will be expended and how long it will be sustained in the face of obstacles and aversive experiences (Boyd and Vozikis 1994). Personal efficacy is derived from four sources: performance accomplishments, vicarious experience, persuasion and a person's physiological state (Bandura, 1977).

2.7.2.3.1. Self-efficacy

According to Bandura (1989, 1999) among all the mechanisms of personal agency, none is more central than people's beliefs about their capabilities to exercise control over life events. Individual self-efficacy is defined as a person's belief in his or her capability to perform a task (Gist and Mitchell, 1982) and influences the complex process of venture

creation. If a certain behaviour is perceived to be beyond the ability of a person, he or she will not act even if there is a perceived social demand for that behaviour (Bandura, 1977). Boyd and Vozikis (1994) suggest that the identification of key efficacy perceptions may be useful in determining the future performance levels of individuals engaged in a process of new venture creation. According to Chen *et al* (1998), self-efficacy as a construct is concerned with the execution of an action and not its outcome. It is different from other measures of behavioural control such as locus of control in that locus of control measures behavioural and outcome control while self-efficacy concerns only behavioural control. Additionally, self-efficacy is task specific construct examining the individual's conviction that he or she can perform a given task whereas locus of control is a generalised constructs covering a wide range of situations (Chen *et al.* 1998, p.299). Self-efficacy can be applied to a variety of domains so long as the efficacy measure is tailoured to the specific task. Within the same environment people with high self-efficacy could be assessed as being replete with opportunities while those with low self-efficacy see it as full of uncertainty, risks and hardships. They are more likely to endure and persist in their actions in the face of adverse conditions. This is because self-efficacy encourages individuals to view situations in terms of opportunities rather than threats (Krueger and Dickson, 1994). The importance of self-efficacy as a determinant of entrepreneurial behaviour has led many researchers to develop measures of the construct in entrepreneurship research (Chen *et al.* 1998, McGee *et al.* 2009, Zhao *et al.* 2005, DeNoble *et al.* 1999) and to lead others to investigate the factors which enhance self-efficacy and how these relate to entrepreneurial intentions (Boyd and Vozikis, 1994, Lee *et al.* 2010, Trevelyan, 2009).

A recent line of enquiry has also emerged in entrepreneurship research focused on the role of entrepreneurial expert cognitions and their influence on intentionality (Busenitz and Lau, 1997). Entrepreneurial expert cognitions are defined as the thought structures and processes that lead to entrepreneurial intentions (Busenitz and Lau, 1997). According to

these authors, these cognitions represent scripts, schemas, knowledge structures and interpretive systems which help individuals to take decisions. The Busenitz and Lau (1997) model suggests that the venture creation decision is influenced by cultural values, social context and personal variables. Extending this work, Mitchell *et al* (2000, p. 975) studied the influence of culture on entrepreneurial cognitions. They defined cognitions as all processes by which sensory input is transformed, reduced, elaborated, stored, recovered and used in the decision making process made up of three scripts: willingness, ability and venture arrangement scripts. Venture arrangements scripts are the knowledge structures that individuals possess about the arrangements needed to engage in an entrepreneurial activity – contacts, relationships, resources and assets. The knowledge structures included a protectable idea, access to resources and venture specific skills. The willingness scripts provided support for the entrepreneur's commitment to venture and the receptivity of the idea of starting something. The ability scripts are the capabilities, skills, knowledge, norms and values that individuals require to create a venture – including situational knowledge about the venture (Mitchell *et al.* 2000, Mitchell *et al.* 2002). This study is focused on perceptual cognitions related to intentionality and not the expert scripts/cognitions which deal with the mental/thought processes that influence decision making.

2.7.2.4. Similarities between the TPB, SEE and Bandura's SCT

There are a number of similarities between these cognitive behavioural models. Firstly, the TPB and the SEE model show that intention is at the centre of planned behaviour and is a robust predictor of future behaviour. Secondly, the models state the importance of attitudes as antecedents of intentions. In short the idea that perceptions rather than objective measures affect behaviours because entrepreneurs enact an environment in which they operate (Krueger and Brazeal, 1994). The three theoretical views suggest that exogenous factors affect behaviour only to the extent that they influence individual cognitions towards the behaviour. The critical constructs in the models are broadly similar in the sense that

perceived feasibility in the SEE model is akin to perceived behavioural control in the TPB (both are similar to Bandura (1977) perceived self-efficacy). Also, perceived desirability is similar to the expectancy-value attitudes of the TPB (social norms and attitudes towards an act) (Krueger *et al.* 2000).Additionally, Steel and Koenig aligned dimensions of the motivation theory (Vroom, 1964) with Krueger's dimensions of feasibility and desirability (Steel and König 2006). They posited that perceived feasibility was akin to expectancy while perceived desirability was comparable to valence. In view of Krueger and colleagues, and the established similarities between intentional antecedents of TPB (Azjen and Fishbein, 1973, Azjen, 1991) and entrepreneurial motivations derived from motivation theory (Vroom, 1964) (expectancy and valence model), perceived feasibility (measured by perceived self-efficacy) and perceived desirability are used in this study to represent farmers' attitudes towards entrepreneurship.

2.7.2.5. Research on attitudes and intentions in agricultural studies

Tranter *et al* (2007) and Gorton *et al* (2008) argue that studies of how farmers view the policy environment and the nature of behavioural intentions is important for policy makers to predict the future of agricultural structure and market balances. Such intentions studies have been applied across a wide range of issues.

Beedell and Rehman applied the TPB to study the attitudes of Bedfordshire farmers in the UK towards conservation. Through the use of multi methods research, they surveyed and interviewed farmers and staff of conservation related organisations to understand their attitudes towards conservation behaviour (Beedell and Rehman, 1996, Beedell and Rehman, 1999, Beedell and Rehman, 2000). Serious difficulties were encountered with the use of the theory with regards to the operationalisation of the constructs to be measured. Because of the dissimilarities in the behavioural measures used, it was impossible to apply

statistical techniques that would have allowed them to provide meaningful understanding of the attitudes. For this reason some authors have dismissed Beedell and Rehman's TPB study as theoretically inaccurate (Wauters *et al.* 2010).

In another study, Gasson and Potter (1988) carried out a survey of farmers' attitudes towards conservation in Suffolk, West Essex and Hampshire areas. Though the study was not based on the TPB, it emphasised the important role of attitudes in influencing behaviour. Interestingly, the authors made use of structural variables and at the end concluded that it was only possible to have a full understanding of farmers' behaviours through a combination of attitudinal and structural factors.

Wauters *et al* (2010) used the TPB to study the adoption of erosion control techniques in Belgian agriculture. Using a sample of 138 farmers, they found that intention was a very good predictor of behaviour. However, the subjective norm and perceived behavioural control constructs of the TPB showed very weak internal reliabilities and consequently little contribution to intentionality, the study concluded that attitudes played an important role in explaining between 44-70% of variance in intentions. Wauters *et al.* suggested that an updated model including farm demographic and structural variables might further improve predictive power.

There are only two known UK studies that have applied a socio-psychological approach to understand farmers' RE adoption intentions (Sherrington and Moran, 2007, Mattison and Norris, 2007). In 2007, Sherrington and Moran carried out a TPB survey of 1500 farmers in Oxfordshire, Nottinghamshire and Scotlandwell counties. Despite a poor response rate of 10%, the study revealed that less than 10% of survey participants had any intention to invest in energy crop production. They realised that normative beliefs of significant others and perceived self-efficacy were consistent positive predictors of intentions. Interesting in

this study was the identification of a range of referents found to be important influencers on farmers' decision making – the most important being the Biomass Energy Centre, power companies, energy producer groups, DEFRA, existing energy crop producers, the farming press and the NFU. According to this survey results, survey respondents were more likely to suggest that agronomists and family would not approve of their intentions to invest in energy crop production.

In another study of 972 farmers by Mattison and Norris in the Norfolk County area of the UK, the authors found that out of the 278 responses obtained (29.32%), 34% intended to grow energy crops (Mattison and Norris, 2007). They noted that farmers with low perceived self-efficacy were less likely to report positive intentions. Measures of attitude, subjective norms and PBC were all significantly related to intentions to grow biofuel sugar beet explaining 45% of the variance in intentions. However, only the PBC related to intentions to grow oilseed rape indicating that other people's views were not important to the farmers when deciding whether to grow this crop.

Some of the most important recent surveys of farmers' intentions have been carried out to investigate the likely/actual response of farmers to agricultural policy incentives (e.g Tranter *et al.* 2007, Gorton *et al.* 2008, Bougherara and Latruffe, 2010). Based on the results of a 2004 European Farm Survey, Tranter *et al* (2007) analysed the likely response of European farmers to the CAP 2003 single farm payment (SFP) scheme based on a 2001/2002 survey of farmers (Tranter *et al.* 2004). The intentions survey of UK, German and Portuguese farmers was found to be useful in that it showed that there would be little change in farmers' behaviours in terms of food production and land use with the introduction of decoupled payments. A major difference in intentions identified suggested that Portuguese farmers were more inclined to idle their lands under the SFP scheme than those from the UK and Germany.

Following up from the Tranter *et al* (2004) intentions survey, Gorton *et al* (2008) investigated the actual behavioural intentions of farmers in five EU countries (France, Slovakia, Sweden, Lithuania and UK) after the introduction of the 2003 CAP reform based on the TPB. The authors argued that gaps between likely responses and actual responses to policy reforms were bound to emerge and therefore the need to revisit the Tranter *et al* (2004) study was justified. The authors found significant differences between farmers from the different participating countries with regards to their attitudes towards the CAP reform, the effects of social norms and self-efficacy but also some similarities. For example, respondents from new EU countries were more opposed to liberalisation than those from the UK and France. There were cross-country similarities between respondents as most thought that the survival of the farm businesses was contingent on some form of policy support. The study also revealed that only 1 in 5 farmers agreed or strongly agreed with the notion that their skills would allow them to maintain adequate levels of farm income. Findings from Gorton *et al* (2008) show that farmers' responses were similar to those obtained by Tranter *et al* (2007) suggesting that farmers' responses before the CAP reform were similar to those obtained after reform.

Since Krueger *et al* (2000) carried out the comparative study of the TPB and the SEE models, there has been a surge in entrepreneurship intentions research using the SEE model, but this has not developed widespread application in farm entrepreneurship research. This research seeks to bridge this gap.

2.7.2.6. Research using entrepreneurial intentions models

Guerrero *et al* (2008) applied the entrepreneurial intentions model to study the impact of perceived feasibility and desirability on entrepreneurial intentions of 33,139 university students in Catalonia. While the study had access to a large student dataset, the use of

single item measures for perceived feasibility and desirability led to inconclusive results especially because students in the sample were at different levels of study and therefore not facing the same entrepreneurial decisions. The application of the TPB and the intentions models should be applied to samples facing entrepreneurial decisions and measures should be at the same level of specificity (Azjen, 1991). In the absence of strong conclusions, Guerrero *et al.* suggested that including institutional variables could improve explanation of entrepreneurial intentions amongst students by making two propositions:

- That there will be a positive relationship between the normative institutional environment and perceived self-efficacy; and
- That there will be a positive relationship between the regulatory environment and perceived desirability of self-employment.

This study contributes to this line of inquiry and seeks to effectively test the veracity of these propositions using samples of individuals who already have established enterprises.

In a comparative study of University student's attitudes towards entrepreneurship from Catalonia and Puerto Rico, Veciana *et al*. extended (Krueger and Brazeal 1994) entrepreneurial intentions model to include demographic variables and role models as external influences on perceptions of feasibility and desirability of entrepreneurship (Veciana *et al.* 2005). The study found mixed results of the effect of these perceptual cognitions and entrepreneurship. For example no relationships were found between gender, social networks and attitudes and intentions in Puerto Rico.

Other recent applications of the entrepreneurial intent model to student samples have been done by Liñán and Santos (2007), Liñán (2008) and Hindle *et al* (2009). All these studies report significant positive results between perceptions of feasibility and desirability of entrepreneurial intentions. The studies also use limited number of exogenous variables to the intentions model (social capital, gender, skills, social networks, demographics). It is

worth nothing that the studies acknowledge the limitations of using student samples, quantitative and cross sectional research designs in the research.

The perceptual cognition theories presented in this section have been shown by research to be robust and parsimonious social-cognitive/psychological process models with ability to predict entrepreneurial behaviour in a wide range of contexts. While these models have been widely applied in mainstream entrepreneurship research, the entrepreneurship intentions model has not achieved widespread investigation by farm entrepreneurship researchers. By testing a refined intentions model, this thesis makes a useful contribution to farm entrepreneurship research.

While the entrepreneurial intentions model holds very good predictive power compared to the TPB as shown by Krueger *et al* (2000), its application has not gone without problems.

First is the process of operationalisation of the variables where the use of single item measures has prevailed leading to disappointing inconclusive results (Guerrero *et al.* 2008). Note is also made of the definition of the entrepreneurial intentions construct as a dichotomous variable despite the fact the intentions are more likely to be a continuum (Krueger 1993, Edelman and Yli-Renko, 2010). Additionally, the use of student samples has been identified as an important weakness in entrepreneurial intentions research. It is also observed that entrepreneurial intention in most of past research has been limited to the creation of new organisations or engagement in self-employment and thus limiting the scope of entrepreneurial actions (Wilson *et al.* 2007, Wilson *et al.* 2009, Liñán and Santos, 2007, Liñán, 2008).

Researchers using these behavioural and socio-psychological approaches have all suggested the need to move beyond individual perceptual cognitions as the main predictors

of entrepreneurial intentions to include possible exogenous influences. It is argued that individuals are predisposed to entrepreneurial intention based on a combination of both personal and contextual factors (Boyd and Vozikis, 1994, Bandura, 1989). Unfortunately, researchers have continued to use a very limited set of exogenous factors and demographic variables are given very little attention (Liñán and Santos, 2007, Liñán, 2008, Sequeira *et al.* 2007). Demographic variables as often referred to as control variables in mainstream entrepreneurship research are particularly important in the farm sector as they tend to represent the farm business' initial resource base when decisions concerning the creation of a new venture on the farm are being considered (Walley *et al.* 2011). The potential influence of exogenous variables on levels of entrepreneurship is discussed next.

2.8. The influence of external environmental factors affecting entrepreneurship

The TPB and the SEE/entrepreneurial intentions models of planned behaviour all suggest that individual behaviours are influenced by exogenous factors through their effect on attitudes (Krueger, 1993, Krueger *et al.* 2000). This has led to the growing recognition that entrepreneurship needs to be interpreted in the context in which it occurs (Welter and Smallbone, 2011). Context provides individuals with entrepreneurial opportunities and sets boundaries for their actions (Welter, 2011). Some examples are shown in table 2.10.

Table 2.10: External factors affecting venture creation

Author (s)	External factors	Direct/indirect effect	Focus	Approach
Lim *et al.* (2010)	Educational system, legal system, trust relationships, financial system	Mediated relationship by cognitive scripts	New venture creation	Empirical
Krueger (1993), Krueger *et al* (2000)	Prior knowledge, Personal, situational, displacement event	Mediated relationship	Intentions	Theoretical / Empirical
Gartner (1989)	Financial support, displacement event, social environment, family	Mediated by opportunity identification	New venture creation	Theoretical
Scott (1995), Kostova (1997), Busenitz *et al* (2000)	Country institutional profile	Direct effects	Entrepreneurial activity	Theoretic/ Empirical
Liñán and Santos (2007), Liñán (2008), Hindle *et al*.(2009), Díaz-Casero *et al* (2008)	Social capital, gender, skills, social networks, demographics	Mediated by perceived desirability and feasibility	Entrepreneurial intention	Empirical
Gnyawali and Fogel (1994)	Government policies and procedures, socio-economic conditions, skills; financial assistance and non-financial assistance.	Mediated by opportunity perceptions, willingness and likelihood to enterprise	New venture creation	Theoretical
Shane (2003), Welter (2011), Welter and Smallbone (2011).	Economic, political and cultural environments	Direct	Entrepreneurship	Theoretical

It is acknowledged that there is "multiplicity of context" and different dimensions affect and influence entrepreneurship in specific ways. Contextual factors influence attitudes, the resources that can be mobilised as well as the constraints and opportunities for creating/starting a new business activity (Gnyawali and Fogel, 1994). These factors impact on the nature, pace and the extent of entrepreneurship as well as the way in which entrepreneurs behave. This has encouraged many studies in entrepreneurship to focus on the external factors which affect entrepreneurial behaviour (Welter and Smallbone, 2011).

2.8.1. Institutions and entrepreneurship

Because of the evidence that external environments affect entrepreneurship, many have been encouraged to adopt an institutionalist framework (Welter, 2011, Welter and Smallbone, 2011, Busenitz *et al.* 2000). According to Szyliowicz and Galvin (2010) as well as Bruton *et al* (2010) the foundations of the institutionalist approaches stem from Meyer and Rowan's 1977 study on the symbolic properties of organisational forms in the area of sociology and organisational research where they looked at the influence of myth and ceremony on organisational attributes and actions. Meyer and Rowan argued that organisational structure reflects not only technological imperatives and resource dependencies, but also institutional forces which were defined at the time as "rule like frameworks, rational myths and knowledge legitimated through the educational systems, by social prestige and by laws" (Scott, 2008). Following up from Meyer and Rowan, DiMaggio and Powell (1983) proposed that organisational attributes and actions were influenced by the institutional environment. The adoption of a practice was explained by the organisation's conformity to institutional pressures in a bid to gain legitimacy.

A major critique of this institutional perspective was its lack of attention to the role of interest and agency. Actors and organisations were considered more or less as being passive given the view that organisations responded to institutional pressures by conformity (Dacin *et al.* 2002). Other research argued that organisations were not passive as they were able to perceive the meaning of institutions and enact the meanings based on their perceptions (Dacin *et al.* 2002). By acknowledging that institutions not only operated top-down but also bottom up led to the development of new institutional perspectives which emphasised the role of power and agency in the process of institutionalisation (Hill, 1995, Peng *et al.* 2009, Szyliowicz and Galvin, 2010). Amongst the works which emerged

(new institutionalism) were those of North from economics and political science (North, 1990, North, 1994).

Institutional theorists put forward the view that the different institutional views from economics and organisational research are in effect complementary (Peng *et al.* 2009, Scott, 1995, Kostova, 1997, Scott, 2008). By drawing from the two branches of institutional theory, a more complete view of the influence of formal and informal institutions on entrepreneurship can be obtained (Szyliowicz and Galvin, 2010). Institutional theory seeks to provide explanations of the interaction between social, regulatory and cultural influences which promote the growth, survival and legitimacy of firms (Bruton *et al.* 2010).

North (1990) defines institutions as the "humanly devised structures which constrain human interaction". They consist of formal institutions such as laws, constitutions, and written rules of conduct while informal institutions are made up of conventions, beliefs, and self-imposed codes of conduct. From an economics perspective, North argues that institutions provide structure to economic exchange by defining the set of acceptable and unacceptable behaviour and the sanctions both legal and social that apply to those who do not respect the rules. Baumol (1990) argues that the "rules of the game" determine entrepreneurial payoffs and define entrepreneur's participation in productive, unproductive or even destructive entrepreneurial activities. According to Minniti (2008), institutions and the policies that shape them allocate entrepreneurial efforts but may also constrain entrepreneurial behaviour (Welter and Smallbone, 2011). Peng, Wang and Jiang (2008, p.922) suggest that institutions govern societal transactions in the areas of politics (corruption, transparency), law (property rights, economic liberalisation, regulatory regime and society (e.g. norms, attitudes towards entrepreneurship). Hill posits that the role of government is to define and police the formal rules which govern exchange (Hill 1995).

2.8.2. Country Institutional Profile for entrepreneurship

The notion of country institutional profiles proposed by Kostova (1997), further developed by Busenitz and others (2000) is used in this study. The country's institutional profile represents the institutional environment of a country made up of all relevant institutions that have been established over time and which get transmitted into organisations through individuals (Kostova 1997). Scott (1995, p.33) proposed a set of three institutional pillars: the regulatory, cognitive and normative that provide stability and meaning to social behaviour.

Table 2.11: Country institutional profile dimensions

Degree of formality (North, 1990)	Examples	Supportive pillars (Scott, 1995)
Formal institutions	Laws Regulations Rules	Regulative (coercive)
Informal institutions	Norms Cultures Ethics	- Cognitive - Normative

Source: Peng *et al* (2009, p.64)

The regulatory institutions reflect the existing laws and rules in a particular country that promote certain types of behaviour and constrain others (Kostova and Zaheer, 1999, p.134). The cognitive institutions refer to the widely shared social knowledge and cognitive categories used by people in a given country that influence the way in which a given practice is categorised and interpreted (Kostova and Roth, 2002, p. 217). The normative component reflects the values, norms and assumptions about human nature and human behaviour held by individuals in a given country.

According to Kostova *et al* (2008), Scott (2008) and Busenitz *et al* (2000), country institutional profiles lose meaning when they are generalised across a wide range of issues. Institutional profiles must, instead be measured with regards to specific domains (quality management, entrepreneurial activity). Anchoring the country's institutional profile on a specific domain (RE) is consistent with the above-mentioned view. Another reason to use the country institutional profiles is because of the limitations observed by Bruton *et al* (2010) in their review of the state of application of institutional theory in entrepreneurship research. They specifically identify three weaknesses in institutional research – the overreliance on single perspective of institutional theory, reliance on the examination of culture as a determinant of entrepreneurship and the use of single country studies. On the first and second issues, Szyliowicz and Galvin (2010) also show in an extensive review of literature undertaken into research using the institutional theory, that most theoretical and empirical studies simply label institutions as "context" or "institutional environment" and often reduce context and environment to culture or occasionally to the political/regulatory dimensions. For these reasons, the much broader understanding of the role of institutions and the insights of institutional theory are lacking in entrepreneurship research.

This research seeks to bridge this gap by tackling the first two deficiencies in the application of the theory by using the framework proposed by Kostova (1997), Busenitz *et al* (2000), Spenser and Gómez (2004) and Manolova *et al* (2008). In fact Bruton *et al* (2010, p 434) suggest that this framework is appropriate given:

> 'the explicit recognition that country differences in entrepreneurship involve more than the cognitive aspect of cultural values. Also, by developing a measure that focuses solely on broader institutional factors influencing entrepreneurship, this research path avoids the generality that has limited the prescriptive benefits that can be derived from the dimensions. The advantages of developing such measures … include the elimination of mono-method bias, the acknowledgement that institutions can be malleable and are not time invariant, and a greater relevance to entrepreneurship'.

The institutional environment may exert direct institutional pressures on an organisation to adopt a practice or the institutional pressures enter organisations through people. As suggested by the institutional perspective, organisational practices have a social meaning that is influenced by the institutional context in which they are deeply embedded and practices are enforced by public opinion, by the views of important referents and legitimated by regulations (Kostova and Roth, 2002, p.216).

As a result, the institutional environment influences the ability of an individual to adopt a practice by influencing the person to understand the practice, the way they interpret and value the practice, and their motivation to adopt it. Positive judgements are more likely when the institutional context is favourable:

> 'one that contributes in a positive way to the adoption of a practice through regulations, laws and rules supporting the practice and or/requiring the practice, cognitive structures that help people understand and interpret the practice correctly; and the social norms enforcing the practice' (Kostova and Roth, 2002, p.218).

2.8.3. Model refinement

This section completes the earlier parts of this chapter which have discussed the effects of personal characteristics, farm business resources and attitudinal factors on entrepreneurship. The effect of the country's institutional profile is discussed leading to the development of research hypothesis.

2.8.3.1. The influence of the regulatory institutional profile on entrepreneurship

The **regulatory** pillar of the institutional theory of entrepreneurship is primarily driven by the provisions of government legislation, industrial agreements and standards (Bruton *et al.* 2010). Busenitz *et al* (2000) define this dimension as consisting of laws, regulations and government policies which provide opportunities, support for businesses, reduces risks and eases entrepreneurs' efforts to acquire productive resources. The RE policy framework

presented in sections 2.1 to 2.3 of this chapter. In the next section, some additional literature is provided on the role of regulatory systems in entrepreneurship more generally.

According to Lim *et al* (2010) government policy shapes the institutional environment in which entrepreneurial decisions are made and therefore influence the allocation of entrepreneurial activities. It has been argued that the institutional environment can lead to productive or even destructive entrepreneurship (Minniti 2008, Baumol 1990) suggesting the need to study how specific institutions affect levels and types of entrepreneurship (Busenitz *et al.* 2000). Significant policy research on the effects of government policies on entrepreneurship suggests that governments seeking to stimulate their economies should reduce constraints on entrepreneurship (Minniti, 2008, Van de Horst *et al.* 2000). While institutions may be fairly stable in developed economies, institutional environments can be very unstable, hostile and even inefficient and detrimental to new and small business venture in developing economies (Manolova *et al.* 2008, Manolova and Yan, 2002, Welter and Smallbone, 2011)

In a study on the effect of the institutional environment on entrepreneurial cognitions, Lim *et al* (2010) used a sample of 757 entrepreneurs and non-entrepreneurs from eight countries. Amongst four measures of the institutional environment adopted (legal, educational, financial and trust relationships), they found that only the legal and financial systems were significantly associated with perceived desirability and willingness to start a new venture. The study revealed that countries with less complex regulatory regimes increased the levels of perceived opportunities and feasibility to create new ventures.

Spenser and Gomez (2004) carried out a multi-country study of the relationships among national institutional structures and entrepreneurial activity. They adopted the instrument validated by Busenitz *et al* (2000) and found out that the effect on entrepreneurship was

mixed. For example they found that regulatory dimension was actually negatively related to self-employment, there was no association with the prevalence of small firms but a positive relationship was found for the relationship between the regulatory environment and new firm listings in the stock exchange. This research showed that government's role is not always straight forward and its effect on entrepreneurship is not uniform.

Kostova and Roth (2002) carried out a ten country study to analyse the adoption of quality management practice in multinational companies based on a sample of 7,509 employees and 1,070 senior and non-senior managers. Surprisingly the study found negative effects of the regulatory profile on the adoption of an organisational practice by employees while the cognitive and normative dimensions were all positive and significant. It emerged that regulations may lead to unexpected or counter-productive results if regulations are seen as being coercive.

Research by Meek *et al* (2010) in the US solar sector showed that the availability of state solar incentives was positively related to rates of creation of new solar energy enterprises. The availability of financial incentives reduces cost entry barriers and enhances investors' abilities to take advantage of opportunities in the RE sector. They showed evidence suggesting that the efficacy of state incentives on new solar energy firm creation was moderated by the types of social norms existing in the state.

The effect of government intervention in the entrepreneurial process in Norway was subject of a study by Jenssen and Havnes (2002). Using beneficiaries from three government supported entrepreneurship programmes, they observed that the programmes assisted entrepreneurs with human, social and financial support. For example, study participants suggested that access to support had improved networking but stated that they did not receive enough help as they would have loved to develop their business networks

(Jenssen and Havnes, 2002). Another study on the effectiveness of business support in Russia shows that government policies can also inhibit entrepreneurship (Dadashev *et al.* 2003). This study observed the lack of regulatory and legal frameworks for small businesses. Small businesses had problems accessing credit because of lack of capital and the fact that formal banks were reluctant to provide credit due to lack of collateral. Unfortunately resources allocated to government ministries to support businesses were often used by bureaucrats to support their own businesses.

Many government sponsored organisations have emerged with the objective of providing assistance to farmers interested in RE in the UK. These include public and private sector organisations. The most prominent are government sponsored departments: Department for Environment, Food and Rural Affairs, Department of Energy and Climate Change; non-department public bodies: Environment Agency, Research Councils and quasi autonomous government agencies: Carbon Trust, Energy Saving Trust and Ofgem (Slade *et al.* 2009). These structures provide and facilitate access to information, technical and managerial skills, and market information. Such assistance may help facilitate access to other types of resources such as funding needed by the entrepreneur (Flynn, 1993).

The ability of the entrepreneur to put together financial resources is very important for the take-off, growth and subsequent survival of any business (Alsos *et al.* 2006). Financial incentives are particularly relevant for RE deployment because they offer the possibility for farmers to carry out farm investments which might not be justified by purely potential economic returns (Meek *et al.* 2010). Incentives are also valid considering that the initial investment for RE Technologies (RETs) is usually costly and of a capital nature. In effect, most countries involved in the promotion of this type of energy employ some form of financial support. It is estimated that between 2005 and 2008, the UK government support

for RETs was estimated at about £8.5bn. This covered subsidies and grant schemes, research and development and other support services (Pollitt, 2010).

A favourable regulatory framework is one which creates opportunities for investment and also facilitates access to resources and capacities that are required by investors to take advantage of identified opportunities.

2.8.3.2. The influence of the cognitive institutional profile on entrepreneurship

The cognitive institutions refer to the widely shared social knowledge and cognitive categories (for example schemata, stereotypes) used by people in a given country that influence the way in which a given practice is categorised and interpreted (Kostova and Roth, 2002, p. 217). It has even been defined more narrowly as the knowledge and skills possessed by people in a country pertaining to the creation and operation of a new business (Manolova *et al.* 2008). This dimension can therefore operate at the individual level and influences the ability of the entrepreneur to invest.

Education, advisory services and training systems are components of the cognitive institutional environment which encourage individuals to be more entrepreneurial as they provide key skills and information needed to start up initiatives (Jenssen and Havnes, 2002, Spenser and Gomez, 2004). According to recent research outcomes, the feasibility of a venture depends on many factors amongst which are the market, opportunities, access to finance and one's own abilities and capabilities to create and develop the venture (Trevelyan, 2009). There are actually mixed results regarding the effects of training and educational systems on venture creation.

For example, using an institutional approach, Kostova and Roth (2002) and Gomez and Spenser (2004) found positive relationships between a cognitive institutional profile and

levels of entrepreneurial activity. According to Kostova and Roth (2002), what is important for the adoption of a practice is having social knowledge about the practice (quality management), which helps people understand the practice correctly, and having a set of societal values and beliefs that are consistent with the practice. In another study on the effects of the institutional environment on entrepreneurship, Lim *et al* (2010) did not identify any relationships between a country's educational system and attitudes towards entrepreneurship.

Recent trends in the agricultural landscape in Europe (globalisation, increasing energy prices, the CAP reform, recession, etc) have increased demands on the skills required by farmers to succeed in their activities. Farmers no longer need skills only to produce food and fibre, but they need marketing, management, networking and other types of skills to realise new business opportunities (Rudman, 2008). Skills are defined as the "competencies required to accomplish tasks and activities related to the farm business which can be acquired by learning and experience" (de Wolf and Schoorlemmer, 2008). These skills are categorised into professional, management, opportunity, strategic, and cooperation/networking skills. These are the intangible resources embedded in the enterprise (McElwee, 2008b).

De Wolf and Schoorlemmer (2008) suggest that skills are required to follow cost reduction, value adding and diversification strategies as a response to the environmental context in which farms operate. In this sense, entrepreneurial skills are needed to enhance farm survival and at the same time, take advantage of opportunities that are created by the changing farm context (Vesala and Pyysiäinen, 2008). The personal experience, knowledge, education, and training are the human resources that business founders bring to the enterprise (Rotefoss and Kolvereid, 2005). Firms are also able to improve on their human resource or social capital through capacity building and advice (Mole and Keogh,

2009). Chow specifically shows that access to education and training plays a vital role in fostering entrepreneurial spirit (Chow, 2006).

The influence of skills and value perceptions and how they affect entrepreneurial intentions was subject of investigation by Linan (2008). She found that there were positive relationships between perceived feasibility and desirability of a venture and entrepreneurial intentions. Other studies have found mixed results between access to educational/entrepreneurship programmes and perceptions of self-efficacy and desirability of starting new ventures. For example Zhao *et al* (2005) and Kuehn (2008) found positive relationships between perceptions of formal learning and intentions, no correlations were found between education and self-efficacy (Chen *et al.* 1998) while Peterman and Kennedy (2003) reported mixed results between access to an entrepreneurship programme and perceptions of self-efficacy and desirability of self-employment.

RE technologies are new and demand new skills from farmers who are interested in investing in them or those that adopt them (Sherrington and Moran, 2010). Investments can be increased by improving the capacities of managers to handle these new activities (Bokusheva *et al.* 2007). Evidence from the United States shows that new energy technologies required managerial skills and farmers need to stay updated to keep their projects in operation (Ernst *et al.* 1999).

Domac *et al* (2005a) argue that a common constraint for bioenergy development in the EU is inadequate information and awareness among stakeholders in the economy
and politics. The lack of awareness on the numerous advantages of biomass and bioenergy and their consequent poor acceptance has often been highlighted as an important disincentive for their use and adoption (NFU, 2005). One major challenge for the agricultural sector is to enable farmers to have access to information and develop

entrepreneurial skills (Vesala *et al.* 2007). Skills and knowledge is also needed on: (i) how to legally protect a new business; (ii) how to deal and manage risk as well as (iii) where to find information about markets for their products (Busenitz *et al.* 2000). Farmers need trusted, clearly independent, practical and specific information at an individual farm level to help them make investment decisions and take on new ventures. Research must provide understanding of the information and skill needs of entrepreneurs. This information has to be tailoured and made available through sources that are most appropriate and accessible to those in need (Sherrington *et al.* 2008).

2.8.3.3. The influence of the normative institutional profile on entrepreneurship

The **normative** pillar of the administrative theory of entrepreneurship refers to the degree to which residents of a country admire entrepreneurial activity and appreciate creative and innovative thinking (Kostova, 1997). The normative institutions also exert influence because of the social obligation to comply, rooted in social necessity in what an organisation should be doing. They are typically made up of values (what is preferred) and norms (how things are to be done in line with the values (Bruton *et al.* 2010). The normative pillar represents actions that organizations and individuals ought to take – behaviors that may not be rational in the economic sense but which individuals think of as good nonetheless (Bruton *et al.* 2009). According to Busenitz *et al* (2000), a favourable normative institutional environment for entrepreneurship is one in which: (a) entrepreneurship is admired; (b) society appreciates innovative and creative thinking as a route to success and (c) turning ideas into business is admired as a career path by society.

The domain of environmental protection is an area with a lot of normative influence and as such countries with a strong emphasis on developing a green economy may increase

normative support for local actions that are taken towards achieving "green objectives" (Plieninger, 2006). Problems that may result in the development of social norms include amongst many others, issues like climate change, pollution, nuclear radiation etc. (Meek *et al.* 2010). Environmental awareness has increased worldwide in recent years following a great deal of media and governmental action (IFPRI, 2006, IPCC, 2007). Such societal awareness creates pressures on individual actions either facilitating or constraining environmental entrepreneurship. These social pressures or norms refer to the behavioural acts that are approved or disapproved by others (Burton and Wilson, 2006). With literature on institutional environments largely focused on the regulatory dimension, there is little written on the normative dimension (Manolova *et al.* 2008).

According to Roos *et al* (1999), there is a social dimension of bioenergy choice and social structures such as status, solidarity and conflicts influence the development of a bioenergy market and social criteria have been consistently identified as being decisive in making bioenergy projects viable (Buchholz *et al.* 2009). For this reason, Wüstenhagen *et al* (2007) recognise that despite the ambitious policy targets that are often set by governments regarding the contribution of RE in many countries, social acceptability of the technologies may be a constraining factor. Stenholm *et al* (2011) found evidence of a negative relationship between a country's normative environment and type of entrepreneurial activity, suggesting the possibility that even if entrepreneurship is a socially acceptable choice, pursuing growth and innovation-oriented new venture may not be.

Proponents of RE often face the challenge of altering the perceptions of the public and politicians because public perceptions often focus on the negative aspects of RE creating considerable normative barriers to implementation (Upreti, 2004, Upreti and van der Horst, 2004, Upham and Shackley, 2007, Upham *et al.* 2007, Upham and Speakman, 2007, Upham, 2009). Increased democratisation of information/ and or of the planning processes

may reduce opposition to RE technologies and facilitate uptake (Breukers and Wolsink, 2007, Jobert *et al.* 2007). Meek *et al* (2010) show that social norms have a strong influence on the founding rate of solar energy enterprises in the United States, arguing that states with higher norms of environmentally responsible consumption have higher levels of solar energy deployment.

One other way in which normative institutions guide behaviour is by defining what is appropriate or expected in social and commercial situations. They represent models of behaviour based on obligatory dimensions of social, professional and organisational interaction. In effect, normative institutions interact with individuals and give rise to socially accepted behaviour (Grewal and Dharwadkar, 2002).

Krueger *et al* (2000), Azjen (1991) and Sherrington and Moran (2008) show that the normative beliefs of significant others (family, friends, business advisors, agronomists, accountants, membership organisations etc.) impact on individual perceptions of desirability (positiveness) and feasibility (controllability) of engaging in a new venture. These influences are simply referred to as social networks by Sequeira *et al* (2007). They define social networks as persons to whom an individual personally relates at a social level – family, friends, and colleagues. This could be informal (family and friends) or formal (business networks…). According to Baughn *et al* (2006a), social support for entrepreneurship including the support of family and friends reflect societal norms.

Entrepreneurs bring in those who are close or distant to them for different kinds of help and support. In this sense, social network members can contact, organize and expand themselves making more opportunities available to the entrepreneur (Greve and Salaff, 2003). Networks and contacts are needed during initial screening of potential ideas as wider contacts improve the ability to recognise opportunities (Morgan *et al.* 2010). Family,

for example, can foster normative support through setting high ethical standards, positive commercial values and a sense of responsibility which can contribute towards entrepreneurship (Poutziouris *et al.* 2004). Meert *et al* (2005, p.88) state that:

> 'strong social networks are often a key factor for the successful development of new activities in the farm household. Therefore, the combination of successful market integration with an established social network may be critical to the sustainability of the farm business'.

Investments in RE production tend to be long term in nature. As such long term market contracts and succession issues are bound to be discussed in the family before investments are made. This is particularly so where the farmer is old, where a successor has been identified for the farm or where the farm is managed as a family partnership (Sherrington *et al.* 2008). Where family support is available, decisions to invest in RE can be made easy. Farmers make use of the skills of the different family members in different ways; filling grant application forms, creating networks, market negotiation etc. In effect Meek *et al* (2010, p. 506) find that

> 'family interdependence has a link to environmental entrepreneurship through intergenerational transfer of ownership suggesting that if families place a high value on healthy environments, future generations of family business owners may place a high emphasis on investing in environmentally friendly but profitable enterprises'.

Recent research shows that networks directly influence interests, intentions and decision making processes (Sequeira *et al.* 2007). Sequiera *et al*. operationalised social networks as consisting of weak and strong ties and found that individuals with strong social ties were significantly more likely to develop positive intentions towards entrepreneurship. They also found relationships between access to social networks and self-efficacy. Other research suggests that networks can provide financial capital, information, potential employees, access to clients but also understanding, encouragement and support that family and friends are able to offer (Welter, 2011). In a study of the propensity for self-employment amongst student samples in the United States of America and Mexico, Prieto

et al (2010) found significant results for the effect of social networks on propensity for self-employment. Social networks had a strong significant influence on entrepreneurial self-efficacy and risk propensity.

According to Estay (2004), networks and family as well as the existence of strong links with those in the same sector, give confidence to the entrepreneur with his progress towards business creation. Social and market networks improve access of the entrepreneur to valuable resources needed for the venture – connections, finance, counselling and advice, and legitimacy (Zhang and Wong, 2008). Social networks favour entrepreneurial alertness and hence the perception of opportunities (Ardichvili *et al.* 2003, Ardichvili and Cardozo, 2000). The role of networks in the entrepreneurial process was subject of another study in Saint John Local County in Indiana by Birley (1985). Of the 160 usable responses obtained from a mail survey of 703 firms, it emerged that entrepreneurs hardly made any mention of formal sources in the process of assembling resources to start new firms. Business contacts, friends and family were reported as the most important sources of required resources (Birley, 1985). In a recent conceptual argument, De Carolis and Saparito (2006) contend that social capital and individual cognitions facilitate entrepreneurship (identification of opportunities) but can also deter entrepreneurial activity.

The relationship between social capital and perceptions of desirability and self-efficacy on entrepreneurial intentions of students was subject of study by Liñán and Santos (2007) and Hindle *et al (*2009) who all concluded that social networks were important in the venture creation process by providing assistance in the process of discovery, evaluation and exploitation of entrepreneurial opportunities. It can be hypothesised that support of family, friends and associational/business networks influence entrepreneurial intentions as well as attitudes towards entrepreneurship.

2.8.4. Conceptual Framework for the study

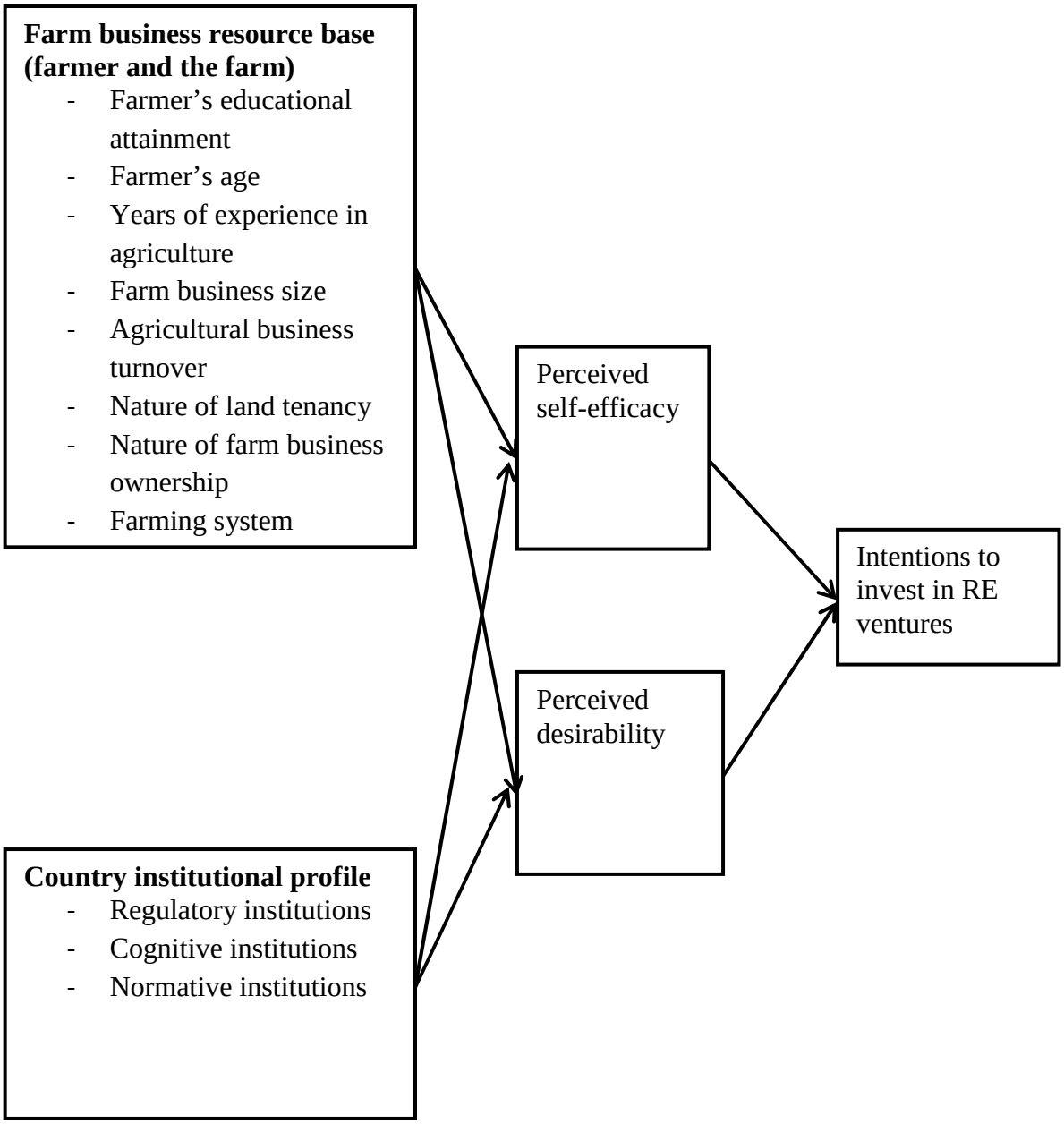


Figure 2.8: Conceptual framework for the study

2.8.5. Research aims and hypotheses

This piece of research has the following aims:

1. To investigate the level of deployment of RE on UK farms;
2. To investigate the extent to which RE enterprises contribute to farm business performance;
3. To assess the types of RE ventures available to farmers;
4. To assess the motivations for adoption and the constraints which hinder greater adoption of RE enterprises on UK farms; and
5. To determine the factors which influence future behaviour regarding farmers' intentions to invest in RE enterprises.

In line with number 5, the following research hypotheses were proposed given the conceptual framework developed in 2.8.4.

H1: The farm business resource base will influence farmers' intentions to invest in RE enterprises

H2: The country's institutional profile will influence farmers' intentions to invest in RE enterprises

H3: There are co-dependencies between the different dimensions of the country's institutional profile and their influence on farmers' intentions to invest in RE enterprises

H4: Farmers' perceived self-efficacy and desirability of RE enterprises will influence their intentions to invest in RE ventures

H5: There are moderation effects between perceived self-efficacy and perceived desirability of RE enterprises in their influence of RE investment intentions

H6: The influence of the farm business resource base on farmers' intentions will be mediated by perceived self-efficacy and desirability of the RE enterprises

H7: The influence of the country's institutional profile on farmers' intentions will be mediated by farmers' perceived desirability and self-efficacy of RE enterprises

Chapter three presents the research design and the methods used to achieve the aims defined in this study.

Chapter 3: Research Methodology

3. Introduction

Chapter 2 of this thesis discussed past research on RE policy and farm entrepreneurship. The theoretical framework and research hypotheses were developed. Chapter 3 presents the research design and methods used to achieve the research aims proposed in chapter two.

This chapter is organised into 5 main sections. Section 3.1 to 3.2 discusses the philosophical position in the research, the research approach used in the study, its methods, strengths and weaknesses. Section 3.2 specifically deals with a discussion of the sequential quantitative methodological choice taken in the study, its strengths and limitations. Following that is sections 3.3 and 3.4 which present the research procedures and techniques adopted in the sequential quantitative research methods approach adopted in the study. The first part presents the pilot qualitative study phase while the second is a detailed discussion of the postal quantitative survey of 2,000 farmers in the West Midlands Region of the UK. Sections 3.5 and 3.6 are the final parts of the chapter and deal with the data analysis procedures and techniques. Key procedures presented here refer to the operationalisation of variables, principal component analysis and internal reliability analysis of model constructs developed in sections 2.7-2.8 chapter 2. Bivariate, path analysis and multivariate data analysis processes are presented. The chapter ends with a discussion of the reliability and validity of the research design and methods used in the study. The first section starts with a discussion of research approaches in the social sciences.

3.1. Philosophical position and research approach

Sale *et al* (2002) define a paradigm as a patterned set of assumptions concerning reality (ontology), knowledge of that reality (epistemology) and the particular ways of knowing that reality (methodology). Saunders *et al* (2009) define it as relating to the development of knowledge and the nature of that knowledge. According to Maylor and Blackmon (2005) it describes the ontological assumptions (objectivism and subjectivism) about the nature of reality and highlight what is considered to exist and what is not. There have traditionally been two philosophical foundations for the study of social phenomena - the positivist also referred to a traditional, empiricist/quantitative and the interpretist, constructivist, naturalistic, or phenomenological philosophical foundations (Burns and Burns, 2008). Because of this dichotomy, the debate into the factors affecting the choice of a philosophical stance in social research has often been framed in terms of choice between the positivist and subjectivist (Saunders *et al.* 2009).

The phrase “positive philosophy” was coined by Auguste Compte in 1848 (Martineau, 1868). The ontological position of this paradigm is that there is one truth, an objective reality which exists independent of human perception (Sale *et al.* 2002). It suggests that research should regard all phenomena (astronomical, physical, chemical, physiological and social) as therefore subject to invariable laws. Given this basis, positivism limits its conception of knowledge, science, to what is observable (Burns and Burns, 2008). Epistemologically, investigator and investigated are independent entities and the investigator is capable investigating phenomena without influencing a situation or without being influenced by it (Sale *et al.* 2002) and little can be done to alter the nature of the data collected (Gill and Johnson, 2010).

That reality exists and is external to the investigator is contested with the view that actors exist in a subjective world where people experience physical and social reality in different ways - reality is socially constructed (Sale *et al.* 2002). These researchers argue that ontologically, there are multiple truths and multiple realities and different from the quantitative paradigm, the investigator and investigated are linked and mutually take part in the creation of reality. In effect it is suggested that reality is created within a particular context which shapes the inquiry. The assumptions on which the positivist approach is built have also been challenged on three main grounds (Gill and Johnson, 2010 p 7):

1. That there is no single method which generates scientific knowledge in all cases;
2. That what may be appropriate method for researching the natural and physical world may be inappropriate in the social world; and
3. That knowledge generated is affected by the goals of managers and their validation criteria.

Saunders *et al* (2009) contend that individuals perceive their environments in different ways as a result of their interactions with other social actors. The subjectivist/interpretivist approach then allows researchers to gather and analyse information conveyed through language and behaviour. For instance information about perceptions, values, needs, feelings and motivations (Burns and Burns, 2008).

There are three types of studies in the social sciences, exploratory, descriptive and explanatory/correlational (Saunders *et al.* 2009). Exploratory studies are used to clarify the nature of a problem or to assess an issue in a new light. Descriptive studies on their part aim to provide an adequate profile of events, persons or situations and may be used as an extension or a forerunner to a piece of exploratory or explanatory study. Explanatory studies aim to establish causal relationships between variables in a bid to explain relationships between variables. According to Blumberg *et al* (2005) the essential

differences between descriptive and causal studies lie in their objectives. Given the objectives of this study stated in chapter 2 section 2.8.5, it is clearly the fact that the purposes of this study were descriptive and causal in nature. A research design was developed to achieve the aims of the study.

The research design is the "blueprint that enables the person involved in a piece of research to structure a research problem in such a way that the outcome is the production of valid, objective and replicable answers (Gill and Johnson, 1991). According to Miller (1991), the research design provides information on the proposed design for tasks such as sample selection and size, data-collection method, instrumentation, procedures and ethical requirements. Saunders *et al* (2003) describe a research design as the general plan of how the research questions will be answered. It should contain clear objectives, specify the sources from which you wish to collect data and consider the constraints that you will have (Saunders *et al.* 2009). It should be time bound, based on research questions, guide the selection of sources and types of information, provide the framework for specifying the relationships between study variables as well as outline procedures for all research activities (Blumberg *et al.* 2005). An effective design should lead to the production of valid and reliable research findings (Maylor and Blackmon, 2005).

3.1.1. Deductive/quantitative research

Deductive research is the dominant research approach used in the natural sciences. It is bound up with the assumptions of positivism (Gill and Johnson, 1991). Research involves the development of a theory that is subjected to rigorous testing (Saunders *et al*. 2009). According to Saunders and others, deduction research design has a number of important characteristics. First it involves development of hypotheses which detail the proposed causal relationships between variables. Second, hypotheses are tested through the collection and analysis of quantitative data and third, controls need to be built in to ensure

the validity of the results. For hypothesis testing to proceed, concepts need to be operationalised to enable the facts to be measured quantitatively facilitating future replication. The final characteristic of the quantitative approach is generalisability. For the final characteristic to hold, Saunders and others recommend the selection of sufficient sample sizes using probability sampling techniques. The most common methods used in deductive/quantitative research include experimental studies, re-analysis of secondary data, structured questionnaires and structured interviews (Bryman, 2006)

The possibility for replication and generalisation are the most important advantages of the quantitative approach (Maylor and Blackmon, 2005). There are however, a number of limitations (Burns and Burns, 2008). Firstly, the rigid application of methods of scientific inquiry based on the assumptions of positivism may only be truly applicable to the natural sciences due to the ability of humans to reflect on their own behaviour and seek meaning and purpose in their own and others' behaviour. Secondly, human beings and business organisations are far more complex than inert objects which are often subject of research in the physical sciences. This is because individuals interpret and react to changes in the environmental forces impacting on them.

3.1.2. Inductive/qualitative research

This research approach is the converse of the deductive approach. Rather than moving from theory to observation, the inductive approach starts from observation to the construction of explanations and theories about what has been observed (Gill and Johnson, 1991). Two arguments are used to justify the use of the inductive approach in the social sciences. Firstly, researchers argue that explanations of social phenomena are relatively worthless unless built on observation and experience. Secondly, and contrary to the deductive approach, supporters of this approach reject the causal model proposed by deductivists as they consider that this form of explanation is inappropriate. Open-ended

surveys, ethnography, focus groups, in-depth interviews and observational techniques are the most popular data collection methods associated with the qualitative research (Blumberg *et al.* 2005, Blease and Bryman, 1986).

Inductive research enables researchers to gather and analyse information conveyed through language and behaviour exhibited in natural settings. Burns and Burns (2008) argue that the answer to every problem cannot be captured through the application of standardised tests and the use of experimental and control groups. There are also a number of weaknesses associated with this research approach:

Firstly, Problems of transferability: qualitative studies seek to understand and describe the world of human experience (Burns and Burns, 2008). Within the qualitative paradigm, research findings are often largely bound to the time, context and people involved in the study. As such results obtained never seem to make any claims of generalisability (Baxter and Eyles, 1996). Secondly, time commitment: one major limitation of qualitative research is the time required for data collection, analysis and interpretation as investigator is expected to investigate phenomena in the natural settings of the subjects (Burns and Burns, 2008).

According to Blease and Bryman (1986) ethnographic/phenomenological approaches bound up to interpretist paradigm are unstructured and tend not to have clearly defined hypothesis for testing. As such replication of research findings is difficult. The key elements of the positivist/interpretivist paradigms are summarised in table 3.1.

Table 3.1: Key elements of the positivist and interpretivist paradigms

No	Positivist paradigm	Interpretist paradigm
1	An objective world with universal laws and causality	Subjective world where people experience physical and social reality in different ways
2	Value free contexts	Socially constructed reality with subjective evaluation and meaningfulness of experience for the individual
3	The use of precise, objective measures usually associated with quantitative data	Researcher fully involved with individual subjects
4	Research is rigorous, linear and rigid, based on hypothesis testing	Flexible research process which flows from material provided by participants

Source: Burns and Burns (2008, p.14)

3.2. Making the methodological choice

The argument about the dichotomy of research approaches has been referred as paradigm wars (Blease and Bryman, 1986). Many authors argue that this may be misleading and it is possible to integrate methods related to the different philosophical foundations (Greene *et al.* 1989). In effect, Bryman contends that the paradigm wars concerning the incompatibility between quantitative and qualitative approaches has subsided leading to more pragmatist stances (Bryman, 2007). This has led to the development of mixed methods (Bryman, 2006a, Bryman, 2006b) and therefore it is very possible to construct a continuum of research methods that allows scientist to differentiate methods based on their logics. At each extreme of the continuum are nomothetic and ideographic methodologies (Gill and Johnson, 1991) as shown in table 3.2.

Table 3.2: Nomothetic and ideographic methodologies

No	Nomothetic methods emphasise	Ideographic methods emphasise
1	Deduction	Induction
2	Generation and use of quantitative data	Generation and use of qualitative data
3	Highly structured research methodology to ensure replicability	Minimum structure and flexibility
4	Explanation via the use of causal relationships and explanation by covering-laws	Explanation of subjective meaning systems and explanation by understanding
5	Use of various controls, physical or statistical, so as to allow testing of hypotheses	Commitment to research in everyday settings, to allow access to, and minimise reactivity of research subjects

Source: adopted from Gill and Johnson (1991, p.36).

The current study was interested in evaluating farmers' investment intentions as well as their experiences of RE enterprises. It was thought that the purely deductive and quantitative approaches used in the natural sciences such as experiments and laboratory studies might not be the most appropriate. This study adopts a pragmatist stance (Bryman, 2006b) and priority is on the quantitative deductive approach – definition of concepts, operationalisation, deduction and testing of hypothesis (Gill and Johnson, 1991, Ivankova *et al.* 2006).

Pragmatism promotes the prominence of technical decisions regarding the choice of methods and the most important criterion is the research question. The epistemological assumptions take secondary place (Bryman, 2006b). Both scientific quantitative and interpretivist qualitative methods are needed to provide information for effective decision making though (Burns and Burns, 2008). Each approach can inform the other through a qualitative-quantitative or quantitative-qualitative sequence through a process of

"rapprochement" (Creswell *et al.* 2006). This is the idea behind the use of mixed methods (Burgess, 1995, Saunders *et al.* 2009, Bryman, 2006a, Bryman, 2006b).

By bringing together different methods the advantages and disadvantages of quantitative and qualitative research methods can be balanced leading to improved explanation of phenomena thereby enhancing validity and reliability of research findings it is posited (Gill and Johnson, 1991, Jick, 1979). Mixed methods can be used for purposes of triangulation, complementarity, development, initiation and expansion (Greene *et al.* 1989). Many typologies are possible depending on timing (simultaneous versus sequential data collection), priority (quantitative versus qualitative methods), integration and type of data strand (Bryman, 2006a, Ivankova *et al.* 2006).

Based on the aims of the study spelt out in Chapter 2 section 2.8.5, a pragmatist, two phase sequential mixed exploratory design was adopted. Firstly an exploratory pilot survey was undertaken using personal interview methods followed by a postal mail questionnaire survey of 2,000 farmers to collect descriptive and explanatory data (Saunders *et al.* 2009). This is a typical development mixed method approach (Greene *et al.* 1989). This approach is often sequential. This means that one method is implemented first, and the results are used to help select the sample, develop the data collection instrument, or inform the analysis for the other method. The hypothetic-deductive approach (Gill and Johnson, 1991) takes prominence over the qualitative approach in this piece of research and seeks to measure and analyse quantitative data in order to explain relationships between variables.

While there are benefits associated with using mixed methods as stated earlier, researchers argue that replicability of the studies may be made difficult (Jick, 1979). There are also barriers involved in the use of mixed methods (Brace *et al.* 2009, p.255-256). Some of which are:

1. Increase in time needed to carry out the study compared to using a single approach;
2. Difficulties in dealing with large amounts of data;
3. Differences in epistemological stances may cause conflict about the research design; and
4. Researchers do not often have the expertise in dealing with multi method approaches.

3.3. Data collection methods

This section presents the data collection and analysis approaches used in the two phases of this study. Section 3.3.1 presents the qualitative pilot survey of farmers in the West Midlands Region. The second section provides detailed information about the design and implementation of the quantitative postal survey phase of the study. This includes discussions about questionnaire development, sampling and sampling procedures, mail procedure, non-response bias analysis and sample representativeness.

3.3.1. The pilot survey

This phase of the study applied an inductive approach and was concerned with understanding and exploring issues related to factors affecting farmers' attitudes and behaviours towards RE. The key issue was to explore farmers' thoughts regarding the viability of RE enterprises and the relevant issues affecting behaviour towards these relatively novel enterprises (Sherrington *et al.* 2008). It was expected that this exploratory phase will lead on to a more descriptive and explanatory phase. In deciding to use field interviews the advantages and disadvantages of this data collection method were assessed (Miller, 1991, p.160-161 and Blumberg *et al.* 2005, p.282-283). These are presented in table 3.3.

Table 3.3: Advantages and disadvantages of personal interview as data collection method

No	Advantages	Disadvantages
1	Personal interviews usually yield high response rates	Higher costs involved throughout the process
2	Information collected may be more correct as it is possible to clarify unclear information	Some areas may be difficult to access
3	May elicit more spontaneous responses	Many researchers do not have adequate training and skill to implement interviews
4	Because of the time involved, recall of information can be facilitated	Life patterns of respondents may mean that respondents are not available during working hours
5	Sensitive information can be collected through tactful posing of questions	Interviewer bias may contaminate responses
6	There is control over the respondent	Labour intensive
7	The interviewer can collect supplemental information about the environment of the respondent	Some respondents are unwilling to talk to strangers
8	Questions can be adapted on the spot to the ability or level of education of the respondent	May yield limited results in areas with wide geographic dispersion
9	Visual aids and scoring devices can be used	

Based on these considerations, it was hoped that nine farmers would participate in the first phase of the study and these were randomly sampled from the category ‘farmers’ in the

West Midlands from the website Yell.com, however two found that they could not in the end participate and seven farmers were finally interviewed. The pilot sample included some who had adopted RE, some who had considered RE and decided not to adopt the technology and others who were yet to consider it. Additionally a wide range of farm types across the five regions of the west midlands was included. Once a farmer accepted to take part in the pilot, an appointment was negotiated to fit with the activities of the farmer. All the interviews took place on the farm/farm office at a convenient time for the farmer. Most of the farmers were willing to discuss as long as it was required of them. Interviews took place between June and September 2010. Discussions with farmers lasted between 1-2 hours and in most cases were followed by a farm visit.

At the beginning of each interview, the objective of the study/visit was restated, confidentiality issues were cleared. Consent was sought to take notes during discussions. The interviews were conducted based on a checklist of predefined questions but these were only meant to serve as a guideline as the free story approach was adopted where the farmer was allowed to discuss whatever issue he/she found important (Miller, 1991). Most times the interview started with a general discussion of the evolution of the farm in the past five years, changes in the farm and the outlook for the farm business. After that discussions tended to dwell on the farmer's assessment of the subject of RE, experiences with RE, attitudes/motivations to adopt bioenergy (or not), barriers (actual /perceived) and proposals to improve the RE sector in the UK.

The interviews with the farmers provided understanding of experiences of the initial adopters and furthered understanding of the factors affecting adoption intentions. Results of the field interviews were used to define and develop a research instrument for research phase two that was sensitive to the issues raised by the farmers but also concerns that were not raised by them. Results of the pilot survey suggested that key issues could be grouped

into six main categories: (1) regulatory issues, (2) Information, knowledge and skills development, (3) normative/social acceptability of the enterprises, (4) farmers attitudes towards the enterprises, (5) motivations for investment, and (6) barriers for investment. In designing the draft questionnaire, these main areas were covered in addition to a section on demographic information. See appendix 2a for brief of the pilot survey.

3.3.2. Research phase two: The quantitative study

3.3.2.1. Questionnaire development

There are three main ways to design questions in a study; i) adopt questions from other questionnaires; ii) adapt questions from other questionnaires; and iii) develop one's own questions (Saunders *et al.* 2009, Saunders *et al.* 2003). Bourque and Fielder (2002) argue that there are three advantages of using standard question batteries:

- Closed ended and possible answer categories have been worked out and tested;
- Instructions have been tested; and
- Research results can be compared with the past results.

Care was taken during questionnaire design to adopt relevant questions for the study and to modify those that were not suited. Because of ethical concerns, permission was requested from a number of authors. A number of favourable responses were obtained (Begley and Boyd, 1987, Businetz *et al.* 2000, Prieto *et al.* 2010). Where responses were not obtained, borrowed items from other studies are acknowledged.

Backed by findings from the pilot survey, discussions with researchers with experience in the area of research and through the review of relevant literature, a draft questionnaire with nine sections covering the independent, dependent and control variables was developed.

The sections are listed below:

1. Regulatory institutions;
2. Normative institutional factors;
3. Cognitive institutions;
4. Perceived desirability of RE ventures;
5. Investment intentions;
6. Motivations and constraints
7. Perceived feasibility of RE ventures;
8. Farm business characteristics; and
9. Demographics.

A number of techniques based on Miller (1991) and Saunders *et al* (2009) were used in the questionnaire development including identification of social and economic background of respondents with closed ended questions (sections 7 and 8), use of Likert scales (sections 1,2,3,4, parts of section 5, and section 6) and open ended questions (section 5.4). The questionnaire contained 56 items, excluding farm characteristics and demographic information. There were 109 variables in total. A copy of the 6 page questionnaire can be found in appendix 3.

The format of a questionnaire is a key issue as it affects response rates (Blumberg *et al.* 2005). For example, it is argued that an easy to difficult progression of questions and vice versa affect response rates (Bourque and Fielder, 2002). Discussions with researchers at UWBS, Warwick Business School[3] and Manchester Metropolitan University[4] led to the

[3] Prof Stephen Roper
[4] Dr Dilani Jayawarna

view that an easy to difficult progression might be better while the NFU thought that the difficult to easy progression was adequate. Following suggestions from the Farmers' Union and recommendations from Saunders *et al* (2009), the difficult to easy progression was adopted on the grounds that the subject was considered salient and starting with demographics might have negated the positive effects of the subject and cover letters

Survey participants were sent a cover letter and a questionnaire. The cover letter was printed on headed paper with the University of Wolverhampton Business School Logo and the National Farmers' Union Logo. Bartholomew and Smith (2006) found significant positive relation between social network endorsement and response rates (A copy of the cover letter is found in appendix 4). Guidance on the structure of the cover letter was obtained from (Saunders *et al.* 2009, Saunders *et al.* 2003). It explained the purpose of the study and expected results, explained to survey participants how their details had been obtained, assured them of confidentiality, informed the farmers of the pre-paid envelopes, the return address and contact details. It also included an incentive to encourage responses. Following suggestions from Brennan and Charbonneau (2009) it was important to acknowledge that they were busy, provided an estimate of the time input required and expressed appreciation in advance for assistance. A shorter version of the letter was used as a reminder letter.

3.3.2.2. Sampling

According to Blumberg *et al* (2005 p. 228), the basic idea behind sampling is that by studying some elements of the population, results can be generalised to the wider population. A good sample is one which represents the characteristics of the population that it is drawn from or at least minimises any in representativeness. The next section presents the steps taken to select the sample for this piece of research (Saunders *et al.* 2009):

1) Identification of a suitable sampling frame

2) Decision on the suitable sample size

3) Selection of an appropriate sampling technique and

4) Assessment of the sample for representativeness.

3.3.2.3. Selecting the sampling frame

> 'A sampling frame is a researcher's operational definition of a population and the validity of generalisation from a sample is conditional on the adequacy of the frame. A useful sampling frame should allow an unbiased sample to be drawn or failing that, should have known biases' (Kalleberg *et al.* 1990, p.659).

Past research has shown that sampling frames are hardly complete catalogues of all the elements of the population and often tend to over register or under register the target population (Carter, 1998, Kalleberg *et al.* 1990, Emerson and MacFarlane, 1995). For this reason, sample source representativeness and coverage offered by different sampling sources are problematic in organisational research and farm surveys (Blumberg *et al.* 2005, Brennan and Charbonneau, 2009, Errington, 1985). It was therefore important to assess the strengths and weaknesses of potential sampling frames.

Two databases were considered prior to the selection of the National Farmers' Union database - Department for Environment, Food and Rural Affairs (DEFRA) and the Yellow Pages telephone directory. A request to use the DEFRA database for the study was made in June 2010 but no favourable response obtained. These lists are generally unavailable to researchers except to those working on government related organisations (Burton and Wilson, 1999, Emerson and MacFarlane, 1995, Errington, 1985). Lack of access to this database, has led researchers to investigate other alternatives (Errington, 1985). Based on a sample of 62 farmers in the Vale of the White House District of Oxfordshire, Errington concluded that "surveys based on the Yellow pages directory will provide estimates of the

values of population parameters sufficiently accurate for most purposes p.251". Many researchers now rely on Yellow Pages on the grounds that there is no alternative to DEFRA lists and following recommendations from the Errington study (Carter, 1998, Emerson and MacFarlane, 1995, Holloway and Ilbery, 1996).

There have been concerns however about the viability of the Yell.com directory. (Emerson and MacFarlane, 1995) compared it with those of the National Farmers' Union of Scotland (NFUS) and Scottish Land Owners' Federation (SLF) using structural farm variables[5]. Their findings suggested that the Yellow pages directory was an unbiased sampling frame for business as characterised by number of holdings while the NFUS lists would be most representative of farm businesses by area of farmland. The fact that the NFU lists may be representative in terms of farm size has an important implication – that if one is interested in the study of production and innovation as it is the case in this study, then large farms are often the most important ones (Clark and Gordon, 1980). Members listed on Land Owners Federation databases were significantly different from non-members based on the structural variables considered. While the studies carried out by Emerson and MacFarlane (1995) and Errington (1985) provide valuable information about classification of farmers based on structural farm variables, they do not provide any information about representativeness in terms of farmers' attitudes, goals and values- especially as concerns environmental decision making (Burton and Wilson, 1999) – an issue at the heart of the current investigation. Burton and Wilson (1999, p.97) found that:

> 'a sample drawn from Yellow pages telephone directory would result in unrealistic negative portrayal of farmers' views in that they would overemphasise the importance of commercial aspects of agri-environmental schemes[6] at the expense of the more conservation oriented ones'.

[5] Area, type, labour, number of holdings

[6] Marston Vale Community Forest (MVCF) in Bedfordshire and the Cambrian Mountains Environmentally Sensitive Area (ESA) in Wales

They argued that the Yell directory was likely to over represent economically well off farmers an issue raised by Clark and Gordon. They indicated that Yellow pages tended to under record small and part time farmers who might not be able to afford business telephone lines (Clark and Gordon, 1980). Based on the strength and weaknesses of the Yellow pages, the NFU database was evaluated following its earlier use by Marsden *et al* (1989). Issues of representativeness, practicality, cost (Kalleberg *et al.* 1990) and sampling error (Kish, 1965) were critical.

Practicality

Errington (1985) argued that the Yellow pages provided readily available lists (85% were listed – 53 out of 62 farmers in the study) and addresses of farmers and the coverage was overall good. This statement is understandable because of the limited geographical area covered by the study and the ease of carrying out a census of all the holdings in the area. Such an approach will not be practicable (Clark and Gordon, 1980, Blumberg *et al.* 2005) in a study with an objective of covering a large area as the West Midlands with about 14,000 holdings (Farm Business Survey, 2011). The NFU readily agreed to participate in the study and the list of members was made available for the study even though with some conditions[7]. Compared to other databases, the list was updated as at January 2011 which is not often the case with telephone directories (Kalleberg *et al.* 1990).

This study was carried out in the West Midlands (Warwickshire, Worcestershire, Shropshire, Staffordshire and Herefordshire) Region which is one of the seven DEFRA agricultural regions of the UK. It was chosen on the grounds that it was convenient to travel within this region for the research project and because it was potentially representative of farming in the UK as a whole. According to the Farm Business Survey

[7] That the NFU will select the respondents for the study – because of data protection measures at the organisation

2010/2011 commentary, the region had about 13,689 holdings in 2010 and covered about 915,412 ha (70% of land in the region and 10.3% of the total agricultural area in England). The area accounts for 14.4% of the cattle and sheep, arable farming makes up 12% of the England total. Agriculture in the West Midlands Region contributed 11.8% of the Gross Value Added for agriculture in England. The West Midlands Region also represents one of the lead regions with potential for RE deployment in the UK (DEFRA, 2010, 2012 see table 3.4). A detailed description of the West Midlands Region can be found in appendix 5 (FBS, 2011, http://farmbusinesssurvey.co.uk/regional/Reports.asp).

Table 3.4: Number and percentages of farms producing RE by region in 2010

Region	% of holdings producing RE	No of holdings
South West	5.9	1,499
South East and London	5.7	778
West Midlands	**4.7**	**641**
East of England	4.7	580
North East	4.7	197
Yorkshire and the Humber	4.2	512
East Midlands	3.9	466
North West	3.1	381
England	**4.8**	**5,054**

Source: DEFRA (2012, p.8)

The West Midlands Region was quite accessible and facilitated achievement of the objectives of the study with the resources available. The choice of geographical locations based on convenience is not uncommon in academic research (Carter, 1998, Kalleberg *et al.* 1990). In addition, the NFU was willing to cooperate, providing some convenience and ease of access to their database. By undertaking this research in a region with particular

potential for RE production the author considered it, on the face of it, to be of similar potential research significance as a nationwide study (Sherrington and Moran, 2010). The next issue considered was the cost of accessing the data base.

Cost

Carter (1998) dismissed the use of the NFU database in her Cambridgeshire study on the grounds of the costs of access. The NFU made the list of members available for the study at no financial cost. This was achieved through a process of incremental access negotiation to the organisation (Blumberg *et al.* 2005). The need to obtain endorsement of the NFU was to further increase legitimacy and response rates from members (Bartholomew and Smith, 2006). The cost of data primary data collection for this study amounted to about 6,000 pounds.

Weaknesses of sampling frames

Kish (1965) argued that there are four main weaknesses of sampling frames which may increase sampling error: missing elements, duplicate listings, cluster and foreign elements.

i. **Missing elements:**

The sampling frame is inadequate in that it does not cover the whole population and/or is incomplete in that some units which are supposed to be in the frame are not. Earlier research has insisted that:

> ‘the problem of missing elements is only important when a researcher is trying to estimate absolute numbers, and do not invalidate a sampling frame when a researcher seeks to establish relationships between various characteristics of the members of the population’ (Errington 1985, p.256) as was the case in this study.

In addition, Ember and Ember (2000, p.357) also argued that:

> ‘in as much as hypotheses are predictions about relationships between variables, any incompleteness in the sampling frame is unlikely to affect sample results in any important way’.

Given that part of this study was related to testing hypotheses and analysing relationships, the problem of representativeness was therefore unlikely to affect the results the more so because a random sampling approach was used to select respondents. Findings by (Kalleberg *et al.* 1990, p. 658-688) buttress the point that

> 'inconsistent coverage itself is not sufficient to strongly argue that a representativeness problem exists in selecting amongst sampling sources. If the key characteristics of the population are located in the sampling frame, despite the poor overlap of average, it maybe that no significant bias and subsequently representativeness problem exists'.

Other studies have used the NFU database and have shown that the NFU database is if not statistically, broadly representative of farmers[8] based on a number of variables including changes in land occupancy and ownership, business organisation, farm labour, nature of farming system, sources of income, levels of indebtedness and family structure (Marsden *et al.* 1989).

ii. **Duplicate listings:**

Some units may be listed more than once therefore increasing their chances of being selected: The NFU database eliminates this problem because when data is exported from the NFU database it comes off in membership number order. Membership numbers are randomly generated when a member affiliates to the organisation (personal communication – NFU).

iii. **Cluster of elements:**

A single entry in the sampling frame may not refer to the unit of study, e.g. individual people but to clusters of such units. The NFU list is made up of individuals who are randomly selected for the study.

[8] Study was carried out in regions including (i) the Metropolitan Green Belt up to 15km around the urban zone in London, north and east Bedfordshire, Staffordshire and west Cumbria. Members listed on NFU membership lists were found to be broadly representative of other farmers in the areas under study.

iv. **Foreign elements:**

There may be units present in the frame which are not units for study. The complete list of members in the NFU West Midlands database at the time of the study had about 6,000 members. This included non-active, honorary members and student members. The database was cleaned to eliminate these foreign elements resulting in a final usable list of 5,111 active farmers (personal communication –NFU).

3.3.2.4. Sampling

There are two sampling designs in research: probability and non-probability sampling (Blumberg *et al.* 2005). Probability sampling design is based on the concept of random selection this being a process which ensures that members of the population have equal chances of being selected. Only probability samples are said to provide estimates of precision. On the other hand, non-probability sampling is arbitrary and subjective and population members do not have the same chance of being selected.

Simple random sampling is often impracticable because in many cases a complete list of the population is not available and cost/time constraints may make its implementation expensive (Saunders *et al.* 2009). Because of this, four alternative probability sampling approaches are used: systematic, stratified sampling, cluster sampling and double sampling (Blumberg *et al.* 2005, p.242). These sampling approaches are mainly used in quantitative research with the objective of achieving representativeness and generalisability of research findings (Saunders *et al.* 2003). As suggested earlier, non-probability sampling is also called convenience sampling. It is the least reliable but cheap and easy to conduct (Blumberg *et al.* 2005, Maylor and Blackmon, 2005). Two main types of non-probability sampling techniques are purposive and snowball sampling. Non-probability sampling is mainly used in qualitative research (Saunders *et al.* 2003). This sampling approach was used in the pilot survey phase of this study.

Sample size: considerations

Saunders *et al* (2009, p.219) provide a guide to the different minimum sample sizes required for different sizes of the population given a 95% confidence level for different margins of error. For example, they propose that for a population of 5,000, a sample size of 357 would be acceptable at a 5% margin of error. They also show that for a population of 10,000,000 a sample size of 384 would be adequate for statistical inference considering a 5% margin of error. Large sample sizes reduce error and increase the degree of confidence that can be placed in the estimate of the population parameters. The level of accuracy considered acceptable for decision making purposes has to be set against the cost of getting it with increases in sample size, it is argued (Burns and Burns, 2008).

In view of typically low response rates in agricultural and RE policy research (Carter, 1998, Evans, 2009, Maye *et al.* 2009, Tranter *et al.* 2011), a response rate of about 20% would be acceptable. Based on suggestions from Saunders and others, a minimum sample size of 384 considering a 5% margin of error meant that the actual sample size had to be set at 1920[9]. With the financial resources available, an adjusted size of 2,000 was adopted.

3.3.2.5. Sampling procedure

A sample of 2,000 farmers was randomly selected for the postal survey from a list of 5,111 active farmer members of the NFU. The membership is broken down per county as illustrated by table 3.5 below. Given that the lists were already structured by county, and did not occur according to some defined variable (type of farm, year of adhesion…), systematic random sampling was considered an alternative to simple random sampling (Miller, 1991). Systematic random sampling is a technique which is implemented by taking

[9]Actual sample size based on Saunders, M., Lewis, P. and Thornhill, A. (2009) *Research Methods for Business Students.* 5 ed. Essex: Pearson Education Limited.= 384*100/20 = 1920

a serially numbered list of units in the population and reading off every nth number from a selected starting point in the sampling frame (Burns and Burns, 2008).

Table 3.5: Sample frame and sample

County	Membership NFU as at January 2011	Sample selected
Herefordshire	889	**348**
Worcestershire	673	**263**
Warwickshire	735	**288**
Shropshire CC	1360	**532**
Staffordshire CC	1454	**569**
Total West Midlands	**5,111**	**2,000**

Source: NFU – personal communication

To obtain a target of 2,000 farmers, a decision was taken to ensure proportionate selection of survey participants per county. A random starting point was selected per county and the nth member selected until the number of expected participants in the survey was attained. For example, the 65th member was selected first in Staffordshire followed by the 69th, 72nd … until the required 569 members were selected.

3.3.2.6. Pre-test

Blumberg *et al* (2008) contend that the final stage to improve survey results is to pre-test the data collection instrument. They argue that pre-tests enable the investigator to gauge participant interest in the questions, check issues of wording, length, timing and understanding of skip instructions. The pre-test was administered by visiting the seven pilot survey participants and requesting that they complete the draft proforma under the my supervision, voicing any concerns they might have about what appeared to be confusing or

ambiguous terminology in the questions and/or skip instructions. Pre-test survey participants were asked to feedback on the length of the instrument. These observations were recorded and taken back for consideration and reflection with the project supervisory team. Other discussions with the NFU led to the conclusion that the draft survey instrument of 8 pages was lengthy and might affect response rates negatively. The length of the questionnaire was shortened from 8 to 6 pages.

3.3.2.7. Mail procedure

The 2,000 questionnaires together with a cover letter were mailed out in February 2011 and a reminder sent out three weeks after. 1,960 questionnaires were effectively delivered. There were 26 non-deliveries – returned to the NFU. Reasons were that respondents had recently moved address and there were incorrect entries of the addresses on the envelopes by the enterprise contracted to do the mail out (personal communication with the NFU).

In deciding to use the postal mail survey for the second phase of the study, an assessment was made of its merits and demerits (Miller, 1991, p.141). Considering its advantages and wide use in entrepreneurship and business research, there were major concerns about the problem of possible non-returns and the fact that there might be significant differences between respondents and non-respondents thus biasing the results. A number of steps were taken to increase the response rates and increase representativeness as well as check for biases.

3.3.2.8. Factors put in place to increase response rates

In deciding to use a mail survey for the quantitative phase of the study, the advantages and disadvantages of this data collection approach were considered – see table 3.6.

Table 3.6: Advantages and disadvantages of mail questionnaire method

No	Advantages	Disadvantages
1	Permits wide coverage for minimum expense, both money and effort	The problem of non-returns is the most important
2	Affords wider geographic contact	Low response rates
3	Reaches people who are difficult to locate and interview	Requires substantial follow up efforts to increase returns
4	Greater coverage may yield greater validity through larger and more representative samples	Potential respondents may not be located, inaccessible or even unreachable
5	Permits more considered answers	Those who answer the questionnaire may be substantially different from non-respondents
6	Greater uniformity in the manner in which questions are posed	
7	Gives respondents sense of privacy	
8	Lessens interviewer effect	
9	Adequate in situations when the respondents need to check information	

Source: Miller (1991, p.141)

In order to mitigate the negative consequences of using this data collection approach, a number of things were done. The timing of the survey was critical considering that farmers are often involved in different farm activities throughout the year. The plan was to send out the survey at a time when they were less busy. Based on discussions with the NFU and experience from past agricultural surveys (Maye *et al.* 2009) the survey was planned to take place between December 2010 and February 2011.

The use of financial and non-financial incentives in mail surveys is common and it was thought that including an incentive would improve response rates (Bourque and Fielder,2002, Brennan and Charbonneau, 2009, Furse *et al.* 1981). It is fair to mention that Church (1993) warns against "the use of incentive systems that offer rewards as contingent upon returned questionnaires. To avoid any potential controversies regarding the use of financial incentives, ethical approval for including the incentive was sort from the University of Wolverhampton Business School Research Committee (SRC). Feedback from the SRC resulted in the use of non-financial incentives rather than financial incentives which according to the response rates obtained, had a significant positive effect on respondents' willingness to complete and return the questionnaires.

A reminder letter was sent out to the respondents two weeks after the initial mail out. No questionnaire was included in this mail out because of the cost implications and also because according to Brennan and Charbonneau (2009) and Heberlein and Baumgartner (1978) replacement questionnaires are not more effective than just sending reminder letters. Other researchers have suggested the use of telephone reminders, first class mail and post cards as a means to increase returns. It was not possible to carry out a follow up using telephone because I did not have access to personalised information about the study respondents and cost limitations meant that first class mail and postcards would be unaffordable.

A first batch of 247 questionnaires was returned by the 14th of March 2011 and another batch of 155 questionnaires was returned after the reminder letter (cut-off date 31st of March 2011). Based on the non-deliveries (26) and refusals to participate (14), 1,960 questionnaires were effectively distributed. 412 questionnaires were returned by March 31st 2011 making a gross response rate of 21.01%. The response rate is judged adequate in view of Murphy (2002), Evans (2009), Maye *et al* (2009), Bougherara and Latruffe (2010),

McElwee and Bosworth (2010) and Tranter *et al* (2011) and who obtained response rates similar to those obtained in this study.

3.3.2.9. Non-response bias evaluation and representativeness

Another problem with mail questionnaire surveys is the fact that respondents may be different from respondents either in their responses to questions or they may not be truly representative of the population. Non-response to a survey can have important negative effects on the representativeness and validity of survey results (Burns and Burns, 2008). According to Armstrong and Overton (1977), the nature of this bias is often hard to estimate because of lack of information about the non-respondents. Three methods are suggested in the literature to estimate non-response bias though: comparisons with known characteristics of the population, subjective estimates and extrapolation (Armstrong and Overton, 1977). Comparisons were made between sample data and some official agricultural statistics obtained from DEFRA and the Farm Business Survey while late and early respondents were compared. The idea behind extrapolation is to find out whether the distributions of the samples come from the same population. If the test of differences is non-significant at $p = 0.05$, then respondents are similar to non-respondents on that characteristic and vice versa. In order to check for differences, respondents returning the questionnaire after the first week and after the third week were compared. Comparisons between those returning the forms before and after the reminder letters were done.

Chi square analysis of all groups showed that there was no significant difference between early and late respondents by farm size, farm structure, tenure, years of experience in agriculture and share of family income from agriculture in 2009. These variables are some of the most important characteristics found to affect decision making and adoption of agricultural innovations (Sattler and Nagel, 2010, Gasson *et al*. 1998, Clancy *et al*. 2011). They have also been used in farm entrepreneurship research as a basis for segmentation of

farmers (Pyysiainen *et al.* 2006). From a policy perspective, McElwee and Bosworth (2010) suggest that they can help policy makers to identify potential diversifiers and to enable more farmers to achieve diversification. Results of non-response bias analysis are presented in table 3.7.

Table 3.7: Non-response bias analysis

Characteristic	**Statistic – X_2**	**d.f**	**Sig .05**
Farm size	8.709	4	0.069
Farm structure	3.268	3	0.352
Tenure	4.320	3	0.229
Family income from agriculture	2.190	3	0.534
Gender	16.035	1	0.000***
Age	3.133	4	0.536
Education attainment	11.157	4	0.025*

***p<0.000, *P<0.05;

Chi square tests showed early and late respondents differed by gender (Chi sq 16.035, d.f 1, p= 0.000). Female respondents were more likely to be late respondents while more educated farmers were likely to be early respondents. This shows that before and after stimulus respondents were similar on most of the characteristics and it can be concluded that non-response bias is minimised in this study. Research findings can be considered to apply to the population of farmers.

3.3.2.10. Comparing the sample with national level data

Representativeness was assessed by comparing respondents with known characteristics of the farming population derived from some DEFRA 2009 agricultural statistics (DEFRA, 2010) and outputs from the 2010/2011 Farm Business Survey (Farm Business Survey 2011). DEFRA and Farm Business Survey Lists are considered to provide near complete

enumeration of farmers in the UK (Emerson and MacFarlane, 1995, Errington, 1985). The FBS is an authoritative UK survey that is conducted on behalf of DEFRA and accepted as representative of UK farming conditions by the UK government and the EU, the standing of the FBS thus adds to the findings of this research. Table 3.8a shows how the sample distribution by age of respondents compares with FBS 2010/2011 reports.

Table 3.8a: Comparison of sample age distribution with FBS figures

Age	Sample	(%)	FBS England Sample	FBS England (%)
Less than 35	12	3.0	1,094	2.1
35-44 years	32	8.2	7,503	14.3
45-54 years	109	27.9	15,224	29.0
55-64 years	129	33.0	17,981	34.3
65 years & older	109	27.9	10,696	20.3
Total	391	100 %	52,499	100%

Table 3.8a shows that the sample distribution by age was very much similar to the national level distribution as shown by FBS research outputs. It shows that farmers between the ages of 35-44 were slightly under represented in the sample (6%) while those from 65 years and above were over represented by 7%. A two sample F test for variance showed that the sample was not significantly different from official figures on age (F 6.33, d.f 4, p = 0.44). The sample distribution was also compared to national level statistics by farm type as shown in table 3.8b below.

Table 3.8b shows that the sample distribution based on the farm type was very much similar to the national level distribution when compared to FBS figures. A two sample F test for variance showed that the sample was not significantly different from official figures on age (F 12.23, d.f=9, p = 0.88).

Table 3.8b: Comparison of sample characteristics and official agricultural stats – farm type

Farm Type	Survey sample	(%)	FBS England Sample	FBS England (%)
Cereals	140	21.7	10,469	19.9
General Cropping	50	7.8	4,873	9.3
Horticulture	31	4.8	3,178	6.1
Specialty Pigs	7	1.1	1,221	2.3
Poultry	21	3.3	1,266	2.4
Grazing Livestock (LFA)	54	8.4	5,935	11.3
Grazing Livestock (lowland)	144	22.4	12,222	23.3
Dairy	80	12.4	7,555	14.4
Mixed	90	14.0	5,780	11.0
Other	27	4.2		
Total	644	100%	52,499	100%

The distribution of the sample by farm size was compared to the national level situation. Table 3.8c shows farm sizes from 5 ha to 100 ha were over represented in this study compared to DEFRA 2010 reports while farm sizes between 100 ha and above were under represented in the sample.

Table 3.8c: Comparison of sample characteristics and official agricultural stats – farm size

Farm size	Sample (%)	DEFRA 2010 (%)
Under 5 ha	2.6	0.3
5-20 ha	9.0	3.9
20-50 ha	14.2	9.1
50-100 ha	26.8	16.1
100 ha and above	47.4	70.6
Total (N=393)	100.0	100.0

The sample was also compared with FBS outputs by the gender of respondents. Table 3.8d shows that the sample once again was broadly similar to the national level distribution of

respondents in the FBS. A two sample F test (F 3.23, d.f= 1, p= 0.92) showed that the samples were not significantly different.

Table 3.8d: Comparison of sample characteristics and FBS results by gender

Gender	Sample	(%)	FBS England Sample	FBS England (%)
Male	334	90.3	50,169	95.6
Female	36	9.7	2,329	4.4
Total	370	100%	52,499	100%

The distribution of the respondents by type of land tenure status is very much comparable with the national level figures as shown in table 3.8e.

Table 3.8e: Comparison of sample characteristics and FBS results by type of land tenure

Tenure	Sample	(%)	FBS England Sample	FBS England (%)
Wholly tenanted	38	9.8	8,333	15.9
Mainly tenanted	43	11.1	8,431	16.1
Mainly owned	125	32.2	16,551	31.5
Wholly owned	182	46.9	19,183	36.5
Total	388	100%	52,499	100%

Based on these results it can be said that though derived from the West Midlands Region of the UK, the sample was broadly comparable to the national farm sector characteristics based on age and gender of the respondents, farm type, type of tenure and farm size (DEFRA, 2010, FBS, 2011). The findings regarding representativeness are broadly in line with those obtained by other researchers using the NFU database (Marsden *et al.* 1989).

3.4. Data analysis procedures

The data was analysed depending on the specific study aim. These ranged from creating simple tables and descriptive figures (charts) (research aim 1 to 4) to statistical analysis through establishing relationships between study variables (research aim 5). The study

used the statistical software package called Statistical Package for the Social Sciences – SPSS version 16.0.

3.4.1. Data screening, missing data and preparation

In total 412 questionnaires were returned and after judging for incomplete returns and non-responses, 393 usable questionnaires were retained representing a response rate of 20.1% The questionnaire was pre-coded and these were entered into SPSS. Checks were carried out to identify mistypes and missing data. Frequency analysis and case summary statistics identified many errors which were corrected. Reverse coded questions were recoded to ensure that answers to the questions were in the same direction.

An attempt was made to assess whether the occurrence of missing data followed any pattern. This is because Hair *et al* (1998) recommend that if data is non-randomly distributed or systematically associated with other variables, then it could distort results of the analysis. There were no systematic trends observed in the missing data. A number of approaches are suggested to deal with missing data including deleting the cases with missing data, or estimating the missing data by using the mean or median (Burns and Burns, 2008). A number of things were done to minimise the effect of missing data on the results. Bryman and Cramer (2008) suggest that in the creation of composite scales based on individual items, that mean scores of the items be used rather than the summated scores. Following their suggestion, the mean score creation procedure in SPSS 16.0 was adhered to. In this approach, a minimum number of non-missing values for a scale to be produced for a participant was set at 50%[10]. For example, when there were 4 items, a participant will have a score of 0 if that participant had more than 2 items missing in the scale. For scales with six items, the minimum number was at 3. So if there were more three missing values, then the participant would have a score of 0.

[10] SPSS Numeric expression for a six item scale = MEAN.3 (X1,….X6)*6. Where x= variables

A combination of tools was used to check for normality of variables including box plots, skew analysis and Kolmogorov - Smirnov tests (Burns and Burns, 2008). Variables have to be normally distributed for them to be subject to parametric tests like independent sample t-tests, analysis of variance tests and multiple regressions (Brace *et al.* 2009, Bryman and Cramer, 2008). A number of items were slightly positively skewed and were transformed using the square root procedure in SPSS 16.0 (Burns and Burns, 2008). After the transformations, they were reassessed to confirm that normality had been achieved.

Examples of negatively skewed variables were: Councils provide support for farmers who want to set up RE on farms, farmers have to comply with too many procedural requirements. Based on recommendations from Burns and Burns (2008, p.153), the transformation procedure was to reflect, square root transform and reflect back. In the first instance however, the variables were directly subjected to square root transformation and normality was achieved. There was no need then for further reflections of the variables. Further checks with histograms and normality curves, skew analysis and Kolmogorov Smirnov tests proved that the variables were normal and hence parametric tests could be applied (Brace *et al.* 2009, Bryman and Cramer, 2008).

Screening of the questionnaires received was done to check for completeness. Questionnaires with large incomplete sections were not used for further analysis (n=12). For example, 7 questionnaires were only half complete with no demographic and/or farm business characteristics section. Other questionnaires were deemed unusable because respondents were retired from agriculture and hence would not represent active farmers (n=7). This left a total of 393 usable questionnaires implying an active response rate of about 20.10%.

3.4.2. Validity and reliability of model constructs

To prepare data for statistical analysis, factor analysis was used. Factor analysis is a technique in multivariate statistics. According to Burns and Burns (2008, p.444), it seeks to: (i) discover the nature of constructs or factors influencing a set of responses and reduce the data set to a small number of factors with minimum loss of information; (ii) identify the nature of the constructs underlying responses and thus the basis of construct validity; (iii) determine what sets of items hang together in a questionnaire; (iv) demonstrate the dimensionality of a measurement scale; and finally (v) generate factor scores representing values of the underlying constructs for use in other analysis.

According to Burns and Burns (2008) there are an infinite number of equally important factor solutions for a given set of items. Because of this possibility, they suggest that the best thing for researchers to do is to select the simplest mathematical solution which is referred to as Principal Component Analysis (PCA). PCA is a widely used approach by researchers (Alsos and Carter 2006, Wang and Ahmed, 2009).

PCA process starts with a correlation matrix revealing the interrelationships between variables. The matrix shows the items that are strongly correlated together under a factor. The constructs or factors are selected on the basis that the items “load” on the underlying factors. Factor loadings are correlations between the factor and the variable (Bryman and Cramer, 2009). By convention factor loadings must be at least 0.30 (Burns and Burns,2008). Factors are extracted based on the amount/magnitude of common variance explained by the factors. The amount of common variance extracted is called the Eigenvalue which in effect is the sum of the squared factor loadings of a particular factor. It corresponds to the equivalent number of variables which the factor represents. The third step involves naming the factors and finally, selecting relevant factors for further analysis.

There are two possible criteria to select the factors for further analysis. The first criterion referred to as the Kaiser's rule requires that only those dimensions with Eigenvalues above 1 should be selected. The second proposes the use of the scree test method where successive Eigenvalues are plotted on a graph. The approach is to look at the graph and spot where the plot abruptly levels out. Only factors located above the point where the graph levels out are accepted. The Kaiser's rule was adopted here.

Before proceeding with these steps, a number of criteria relating to data and participants have to be met (Brace *et al.* 2009 p.346). All the variables were ratio/interval, the relationship between the variables was reasonably linear, and there were more participants than variables. On the last issue, Brace and others suggest that an acceptable ration is 2:1 while others (Burns and Burns, 2008) suggest a ratio of 5:1. Our sample size of 393 was largely sufficient for this purpose.

The selection of factors is not often a straightforward process in PCA and rotation is a step that allows analyst to better identify meaningful factors (Brace *et al.* 2009). Rotation increases interpretability so that there is more discrimination between high and low loadings i.e. maximising the number of high loadings and minimising the number of low loadings (Burns and Burns, 2008). There are two major types of rotations, orthogonal rotations which produce uncorrelated factors and oblique rotations which produce correlated factors. The most common types of oblique rotations are quartimin, promax and oblimin (Hair *et al.* 1998).

Data for the survey was analysed by means of PCA with direct oblimin rotation. Hair *et al* (1998) argue that oblique rotation may be more advantageous to orthogonal rotation as it leads to more realistic factors, provides information about the extent to which the factors are actually correlated to each other and as such makes it possible to obtain constructs that

are more theoretically meaningful. Oblique rotation is applied throughout data analysis in this study. In the first instance, 21 questionnaire items to measure the country's institutional profile were entered into SPSS to carry out a PCA with oblimin rotation. These items were developed based on the scales established by (Busenitz *et al.* 2000, Begley *et al.* 2005, Bowen and De Clercq, 2007, Prieto *et al.* 2010).

A number of checks for factorability were implemented based on recommendations from (Burns and Burns, 2008, p.454-5). First of all, inter-item correlations were computed and the correlation matrix showed significant correlations above 0.30. The Kaiser – Meyer-Olkin (KMO) measure of sampling adequacy was 0.72 and Bartlett's test of sphericity was highly significant. The KMO measures the sampling adequacy and should be greater than 0.50 for a satisfactory analysis to proceed. The Bartlett's test of sphericity is a measure of the degree of correlation between variables. Given that these indicators for factorability were satisfactory, PCA was continued. All the required conditions were therefore met and the PCA could proceed. According to Burns and Burns (2008) one should not continue with factor analysis if one or all of these conditions are not met.

The pattern matrix output in SPSS 16.0 showed 5 components with an Eigenvalue of greater than 1.0 (appendix 6) also indicated 5 components which explained 54.57% of the variance which is considered appropriate in social research (Hair *et al.* 1998). Two items shown in appendix 6 with serious cross loadings between the factors were removed (Wang and Ahmed, 2009).

3.4.2.1. Measures of the country's institutional profile

As mentioned above, PCA of the items developed to measure the country's institutional profile for entrepreneurship in the RE sector showed items loaded on five factors (see details in appendix 7).

Regulatory institutional profile measure

Based on the approach adopted by Bowen and De Clercq (2007) this research developed two regulatory related aspects with possible influence on investment intentions: Regulatory support for RE and regulatory complexity. The first relating to the extent to which the regulatory framework is supportive of RE development and the second related to the degree of regulatory complexity involved in the process of setting up and managing RE ventures. According to Bowen and de Clercq (2007), regulatory complexity refers to the paperwork and administrative formalities that entrepreneurs must confront in the venture creation process. They may act as a barrier to firm expansion and growth. PCA showed that nine items loaded on two regulatory components as expected. Six items loaded on the first construct representing regulatory support for RE. Internal reliability analysis using Cronbach technique showed that the measure was internally reliable with Cronbach α = 0.773 which was over the threshold of 0.60 required in the social sciences (Brace *et al.* 2009). Internal reliability analysis of the items which loaded on the factor can be seen in table 3.9.

Table 3.9: Internal reliability analysis for regulatory support measure

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Government organisations assist farmers start RE	.580	.724
Government sponsors organisations that help farmers invest in RE	.602	.720
Current policies encourage farmers to adopt RE	.476	.750
Local councils provide support to farmers to set up RE on farms	.577	.724
Government grants are available for farmers starting RE enterprises	.501	.745
Banks have funds available for farmers starting RE enterprises	.386	.772

Another 3 items loaded on the second regulatory institutional component and was entitled **regulatory complexity** related to administrative barriers/procedural requirements for investment in RE - the internal reliability Cronbach α of 0.766 - see table 3.10.

Table 3.10: Internal reliability analysis for regulatory complexity measure

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Farmers have to comply with too many procedural requirements	.632	.647
Procedures for grid connection discourage farmers from investing in RE	.550	.737
Local council procedures discourage farmers from investing in RE	.615	.667

Cognitive institutional profile for entrepreneurship in the RE sector

As concerns the cognitive environment, four items loaded on a scale related to shared knowledge about RE, information and skills development structures. The internal reliability was 0.669. This was considered acceptable considering similar results obtained

by compared to 0.64 and 0.68 obtained by Kostova (1997) and Busenitz *et al* (2000) respectively. Results of the internal reliability analysis are shown in table 3.11.

Table 3.11: Internal reliability analysis for cognitive institutional profile measure

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
People know a great deal about RE	.311	.688
Farmers know where to find relevant information about RE	.504	.565
Farmers are familiar with the different financial support packages available to them	.553	.531
There are many training programmes for farmers on RE topics	.446	.606

Normative institutional profile for entrepreneurship in the RE sector

Items designed to measure the normative institutional environment for entrepreneurship in the RE sector loaded on 2 subscales. The first was named normative support of family, friends and business networks while the second was termed social acceptability of entrepreneurship.

Support of family, friends and associational networks

Farm businesses are embedded in a social context (Jack and Anderson, 2002) and the farmer's family, friends and associational networks represent social capital (Greve and Salaff, 2003, Meert *et al.* 2005, Sequiera *et al.* 2007, McElwee and Bosworth, 2010) which the farmer can rely on for advice during market opportunity identification and mobilisation of investment resources. The three items measuring support of family, friends and associational networks ($\alpha = 0.830$) were derived from Prieto *et al* (2010) social networks scale. Table 3.12 shows the results of the internal reliability analysis.

Table 3.12: Internal reliability analysis for the normative support of family, friends and associational networks measure

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
My family has social relationships that can help my business	.743	.707
I have friends and family that can assist my business development	.734	.718
I have business networks that I can count on for help in case of difficulties	.593	.853

Social acceptability of entrepreneurship in the RE sector

Three questionnaire items loaded on this component. The Cronbach was found to be 0.521 which falls below the threshold of 0.70 (Hair *et al.* 1998) or even 0.60 suggested by Brace *et al* (2009) for research in early stages of scale development. The inter-item correlations in table 3.23 showed coefficients below the threshold of 0.30 (Hair *et al.* 1998). For these reasons, the item in bold (table 3.13) was removed and the Cronbach alpha re-calculated for the two remaining items resulting in an alpha of 0.801 which is considered acceptable (Bryman and Cramer, 2008). The two items were used to create the scale variable measuring social acceptability of entrepreneurship in the UK.

Table 3.13: Internal reliability analysis for social acceptance of entrepreneurship

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
People in the UK tend to admire those who start their own businesses	.522	.110
Farmers with successful businesses are admired	.461	.191
Because of climate change investing in RE is a moral obligation	**.089**	**.789**

3.4.2.2. Attitudes towards entrepreneurship in the RE sector

There were 10 questionnaire items related to attitudes (see questionnaire appendix 3 sections 4 and 6.1) towards entrepreneurship. In order to develop a perceived self-efficacy scale, 6 task specific items were derived from established scales of Chen *et al* (1998), McGee *et al* (2009), Krueger (1993), Krueger *et al* (2000) and de Noble *et al* (1999). These items were carefully chosen to assess individual self-efficacies or personal levels of confidence in carrying out **specific tasks** involved in the process of setting up and managing viable RE enterprises and not just general self-efficacies. The items were developed in such a way as to include managerial tasks and entrepreneurial skills related to opportunity identification and resource mobilisation (Pyysiainen *et al.* 2006). Items used to develop the perceived desirability construct were developed based on the works of Shepherd and DeTienne (2005), Mitchell and Shepherd (2010) and Carter (1988) with regards to potential intrinsic and extrinsic benefits to the individual from investing in RE enterprises. Principal component analysis with oblimin rotation showed that KMO test of adequacy was 0.81 and total variance extracted was 53.26% suggesting that PCA could proceed (see appendix 8). PCA results showed that the 10 items loaded cleanly on two components (see appendix 9). The internal reliability analysis of the constructs is presented in the next section.

Perceived self-efficacy construct

Six items loaded on the self-efficacy measure of perceived feasibility of RE ventures. Internal reliability Cronbach α was 0.836. Results of the internal reliability analysis are presented in table 3.14.

Table 3.14: Internal reliability analysis for perceived self-efficacy

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Identify new opportunities and act on them	.576	.816
Find right technology that is needed for the farm	.685	.796
Estimate financial viability of the RE enterprise	.742	.782
Raise enough funds to start a RE enterprise	.632	.806
Lead the planning permission process at local council level	.517	.831
Organise and maintain financial records of your farm business	.541	.823

Perceived desirability of RE enterprises

Four of the ten items developed to measure farmers' attitudes towards entrepreneurship in the RE sector load on a single factor that was labelled perceived desirability of RE. The reliability Cronbach α score for the scale was 0.656 – see table 3.15.

Table 3.15: Internal reliability analysis for perceived desirability of RE ventures

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
There are new market opportunities in RE if I want to exploit them	.361	.635
RE can help improve the economic success of my business	.596	.479
If I start a RE enterprise it will help me achieve other important non-economic goals in my life	.376	.632
RE is a viable business proposition compared to my existing agricultural businesses	.435	.591

3.4.2.3. Farmer/farm resource base characteristics

Dummy variables were developed to capture the different resource characteristics of interest. A dummy variable is a dichotomous variable that represents one category of a non-metric independent variable. Any non-metric variable with k categories can be represented by k-1 categories. A number of farm business characteristics including agricultural turnovers, age, farm type, tenure, ownership status and educational attainment were transformed into dummies for inclusion in the regression analysis. Dummy coding followed the approach proposed by Hair *et al* (1998, p.84) regarding indicator coding. In this approach, a category is omitted known as the comparison group. This category receives all the zeros. In the regression analysis, the regression coefficients for the dummies represent deviations from the comparison group on the criterion variable. The deviations represent the differences between means for each group of respondents formed by a dummy variable and the comparison group. The dummy variables used in this study are presented in table 3.16.

Table 3.16: Table of dummy variables

Variable	**K-categories**	**DUMMY CODING - K-1 categories**
Farm type:	Cereal	DUMCEREAL=1, ELSE=0
	Dairy	DUMDAIRY=1, ELSE=0
Ownership status:	Sole proprietorship	DUM_SOL=1, ELSE=0
	Family partnerships	DUM_PARTNERSHIPS=1, ELSE=0
	Limited companies	DUMLIMCOM=0, ELSE=0
Educational attainment	Below secondary	DUM_BELOWSEC=1, ELSE=0
	Secondary	DUM_SEC=1, ELSE=0
	Above secondary	DUM_ABOVESEC=0, ELSE=0
Agricultural business turnovers in 2009	Less than £50 000	DUM_50=1, ELSE=0
	£50 000-99 999	DUM_50_99=1, ELSE=0
	£100 000-499 999	DUM_100_499=1,ELSE=0
	ABOVE £500 000	DUMABOVE500=0, ELSE=0
Tenancy	Wholly tenanted	DUMWHOTEN=1, ELSE=0
	Mainly tenanted	DUMPARTEN=1, ELSE=0
	Mainly owned	DUMPAROWN=1, ELSE=0
	Wholly owned	DUMWHOWN=0, ELSE=0
Age	Less than 35	DUMAGE35=1, ELSE=0
	35-44 years	DUMAGE45=1, ELSE=0
	45-54 years	DUMAGE55=1, ELSE=0
	55-64 years	DUMAGE65=1, ELSE=0
	65 years and above	DUMABOVE65= 0, ELSE=0

3.4.2.4. Dependent Variable: Intentions to invest in RE

Intention to invest in RE was measured using 3 items as opposed to single measures (Krueger, 1993). Items were adapted from Chen *et al* (1998). PCA revealed that the items loaded on a single factor and explained 82% of the variance (Eigen value= 2.71). The three items were then used to create a scale representing intentionality to invest in RE enterprise

in the UK farm sector. Internal reliability analysis yielded a Cronbach alpha score of 0.892 – internal reliability results are shown in table 3.17.

Table 3.17: Internal reliability analysis for the dependent variable: Intentions

Item	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
How interested are you in investing in RE	.773	.862
How much consideration have you given to establishing RE on your farm	.769	.865
How likely is it that you will endeavour to set a RE enterprise on your farm in the next 5 years	.829	.811

3.5. Data analysis techniques

Primary research shows that farmers are not a homogenous category and operate in complex multi-faceted contexts (McElwee, 2005). Rural entrepreneurship researchers advise on the need to clearly determine the unit of analysis in studies of the agricultural sector (McElwee, 2005; 2006 and Carter, 2001). This is because farmers are considered to be entrepreneurially active individuals and directing the strategy of the businesses that they are responsible for (McElwee, 2008). The unit of analysis in this study is the individual farmer as viewed in the context of the farm holding and business (Tate and Mbzibain, 2011, McElwee and Bosworth, 2010). The study seeks to understand the motivations and constraints to RE investment and future entrepreneurial intentions for current non-adopters. By using only the farmer as unit of analysis, and not the family or farm household, the study agrees with Tate (2010) that this could lead to key individuals who play important roles in the farm business decision making processes to be missed. This study however, explored the role of family support as well as access to associational networks in the RE decision making process. By so doing, the possible bias in the unit of analysis choice is mitigated.

The aims of this study were stated in sections 2.8.5 chapter 2. In analysing the survey data, the first to the fourth aim required a predominantly descriptive analytical approach. This involved summarising data in the form of tables and frequencies and representing some of these in pie and bar charts. Sections 5.1a to h of the data collection instrument appendix 3 enabled objectives 1 to 3 to be achieved. Data from sections 5.3 and 5.4 of the questionnaire provided information needed to achieve objectives 3 and 4.

As for objective three, the questionnaire included a multiple response set with motivations for adoption and an open ended question on the barriers to adoption (research aim 4, section 5.4). Summaries for the motivations of adopters and current non-adopters are analysed. It was important to use open ended questions to elicit responses for investment barriers based on feedback received from farmers during the pre-test of the questionnaire. The diversity of responses received during the pre-test suggested that it will be important to obtain direct responses from respondents and to see whether any patterns emerged which could be compared to existing literature on the subject (e.g. Dautzenberg and Hanf, 2008, Jensen *et al.* 2007, McCormick and Kåberger, 2007, Munday *et al.* 2010, Upham *et al.* 2007, Upham and Speakman, 2007). In deciding which motivations should be used in sections 5.3 of the questionnaire, guidance was taken from RE policy research (e.g. Munday *et al.* 2010, Panoutsou, 2008, Roos *et al.* 1999, Sherrington *et al.* 2008).

3.5.1. Bivariate analysis

In addition to purely descriptive analytical techniques, a key concern was to investigate whether there were any underlying factors which made adopters different from non-adopters. In deciding which test to use to find out about the possible differences, the levels

of the variables[11] (appendix 10) were considered as a guide to the choice of parametric or non-parametric tests (Brace *et al.* 2009).

Non-parametric tests were applied for nominal level data (e.g. farm type, ownership status) and on ordinal level data (e.g. level of education, farm size, agricultural incomes etc.). Interval data was analysed using parametric tests (Bryman and Cramer, 2009, Burns and Burns, 2008). There is a discussion amongst researchers on whether parametric tests should be used on ordinal level data especially data collected using Likert scales (Hair *et al.* 1998). However, parametric tests are routinely applied to data collected using Likert scales in entrepreneurship and small business research (Alsos and Carter, 2006, Carter,1998, Fitzsimmons and Douglas, 2010). It was therefore thought to be appropriate to subject the data obtained through Likert scales to parametric tests.

Some authors show that it is only appropriate to use parametric tests when the data meets the following three conditions: i) the level of measurement is equal interval or ratio; i.e. more than ordinal; ii) the distribution of the scores is normal; and iii) the variances of both variables are equal or homogeneous.

i) Level of measurement

Bryman and Cramer (2009) as well as Burns and Burns (2008) propose that parametric tests can also be used on ordinal level data since the tests apply to numbers and not to what the numbers signify. Despite this argument, parametric tests were only applied on interval level data or data collected using Likert scales. Ordinal and nominal level variables were converted to dummy variables before use in regression analysis following recommendations from Hair *et al* (1998).

[11]Nominal, ordinal, interval and ratio - See annex for detail

ii) Distribution of the variable

Normality tests using analysis of skew, box plots and Kolmogorov Smirnov tests were carried out (Burns and Burns, 2008). Where deviations from normality were observed appropriate transformations were implemented as presented in section 3.5.1.

iii) Equality of variance

The Levenes test of equality (F) test was used to evaluate homogeneity or equality of variance. SPSS provides an independence samples t-test output on a table with two rows. If the p-value is statistically significant, then the variances are unequal and the values on the lower row must be used. Non-significance indicates that variances are equal and the upper row figures must be used as this suggests the pooled variance estimate (Bryman and Cramer, 2009). These rules are followed for all statistical analysis in this thesis.

The first issue in the data analysis was to evaluate for differences between adopters and non-adopters (unrelated samples) of RE enterprises. This was done first of all on farm characteristics and on farmer demographic variables as group variables to assess how farmers they differed on these factors. Because these were mainly ordinal and nominal scaled, Mann-Whitney and Chi-Square tests were used (Brace *et al.* 2009). Further analysis was done on how they differed on the assessment of the favourability of the institutional context and their attitudes towards RE ventures. These variables are considered scale variables and as such parametric independent samples t-test for unrelated samples was used (Burns and Burns, 2008).

3.5.2. Multivariate data analysis

This analysis was carried out to provide understanding of the effect of explanatory variables (farmers' traits, farm business characteristics, institutions and attitudes towards RE) on current non-adopters' investment intentions (dependent variable). In order to determine these effects, multiple linear regression analysis was employed. The strength of

the multiple regression is in the fact that it can be used as a way of measuring the relative importance of independent variables to the dependent variables. In order to realise comparisons between effects, the units of measurement need to be standardised and this is achieved in multiple regression through the computation of standardised regression coefficients or beta weights. These measures use the same standard of measurement and therefore can be compared to determine which of two independent variables is the more important in relation to the dependent variable. Essentially, the coefficients show by how many standard deviation units the dependent variable will change for a one standard deviation change in the independent variable (Bryman and Cramer, 2008).

The multiple coefficient of determination R square provides information about the collective effect of all the independent variables on the dependent variable. An adjusted R square is produced by SPSS and represents a more conservative estimate than the ordinary R square. The adjusted R is reported in this research as it takes account of the number of independent variables and number of respondents (Brace *et al.* 2009). The standard error of the estimate is also reported as it provides additional information regarding how well the regression equation fits the data. It enables the data analyst to determine the confidence intervals that can be used in the prediction from the equation. The standard error of each beta coefficient reflects the accuracy of the equation as a whole and of the coefficient itself (Bryman and Cramer, 2009).

Before carrying out the regression analysis, summary statistics and zero order correlations between variables were undertaken. The bivariate associations showed that most of the independent variables are significantly related to RE investment intentions. The variable that was the most highly correlated to intentions was the perceived desirability of RE ventures ($r = 0.568$, $p = 0.000$). Other independent variables were weakly but correlated with each other. This might have raised the problem of multicollinearity in the analysis.

Multicollinearity is often a problem in regression analysis when Pearson's r between pairs of variables shows a relation at or above 0.80. Multicollinearity is a problem because it means that regression coefficients are likely to be unstable and therefore would be subject to variability from sample to sample. Multicollinearity is likely to emerge when moderation effects are investigated because large correlations are introduced between the proposed interaction terms and the individual predictor variables (Aiken *et al.* 1991). Aiken *et al* (1991) suggests that one way to minimize the chances of emergence of multicollinearity is to mean centre the predictor variables. Other researchers suggest that using standardised scores also remedies the possible effects of over correlation (Dawson, 2011). The second approach was adopted because of its simplicity and the fact that SPSS facilitates the creation of z-scores. Where moderation effects were studied, the individual predictor variable z-scores were used to compute the composite variable before the regression was carried out (Aiken *et al.* 1991). SPSS provides some diagnostic tools to identify problems of multicollinearity including the tolerance levels and the variance inflation factors (VIF) indices (Bryman and Cramer, 2009). All the summary statistics and correlation coefficients (between independent and dependent variable as shown in appendix 11) were below 0.60 and none of the variance inflation factors in this study were above 5 which is well below the guideline of 10 (Hair *et al.* 1998, Bryman and Cramer, 2009) while the standard errors of the beta coefficients were all below 2.0 (Hong and Zhu, 2006). Thus it was unlikely that multicollinearity amongst the independent variables would affect the results.

3.6. Common method variance

To test for common method variance, Harman's single factor test was carried out by loading all the predictor variables into an exploratory factor analysis and examining the unrotated factor solution to verify whether a single factor will emerge from the factor

analysis; or that one general factor will account for most of the covariance amongst the measures (Podsakoff *et al.* 2003). No single factor accounted for the majority of the covariance amongst the measures and therefore alleviating the common method variance concerns. As expected, the rotated factor solution and the scree plot showed 7 factors explaining 62% of the variance.

3.7. Reliability and validity of the research design

For research findings to be considered credible, the research design has to be reliable and valid (Saunders *et al.* 2009). Gill and Johnson (1991) state that design can be evaluated based on four criteria namely, internal validity, external validity (population and ecological) and reliability.

Internal validity: the idea behind internal validity is that the different sections of a study should "hang together" (Bryman and Cramer, 2009). It is concerned with the degree to which the conditions within the research are controlled so that any differences or relationships can be ascribed only to the independent variables (Burns and Burns, 2008). To ensure content validity, preliminary work involved detailed evaluation of the relevant literature. This was followed by the use of qualitative techniques such as open ended interviews and field visits to farms in the West Midlands. This provided the basis for developing the questionnaire for the postal quantitative survey. The use of mixed methods in social research is proposed as an important strategy to improve the validity of research findings (Bryman 2006a, b, Bryman *et al.* 2007).

Issues of access to the NFU database for sampling purposes were dealt with care, ethical concerns were settled, cover letters and questionnaire length and structure were extensively discussed with experts and pilot survey farmers prior to data collection (Punch, 2003). A pre-test of the draft data collection instrument ensured that questions were clear, readable,

unambiguous, and easy to understand and that the layout and time for completion was just right to ensure cooperation of survey participants and hence increase response rates (Saunders *et al.* 2009). By submitting the pilot survey question guidelines and the questionnaires for expert and participant assessment, face and content validity was ensured (Burns and Burns, 2008). Extensive literature review of all areas around the research problem led to the development and use of theoretically valid constructs (see section 2.8.4-2.8.5 for detail) which were subjected to hypotheses testing.

External validity refers to the generalisability of the results to the population of interest as well as to other contexts (Burns and Burns, 2008). This section shows efforts made to reduce threats to validity of the results:

1) The independent and dependent variables used in this study were carefully described and therefore should ensure future replication;

2) To ensure generalisability of results variables were fully operationalised and in most cases the construct items were adopted/adapted from well-established sources;

3) Probability sampling techniques were employed in the quantitative survey and a respectable response rate was achieved;

4) Comparisons with some known characteristics of farmers in the UK based on DEFRA 2009 agricultural statistics and outputs from the national Farm Business Survey 2010/2011 showed that the sample characteristics were broadly in line with official statistics.

Reliability

Reliability refers to the consistency and stability of findings that enables findings to be replicated (Burns and Burns, 2008). A number of issues were taken into consideration to ensure reliability. Burns and Burns (2008) contend that small sample sizes may limit the

power of statistical tests. It can be said that the response rate of 20% and 393 valid responses obtained in this study were adequate to detect the differences or relationships between variables hence reducing the chances of type II errors. The major assumptions of statistical tests were tested and in some cases data transformation was carried out to ensure that assumptions were met before variables were submitted to statistical testing.

Use of established scales: Care was taken in this study to use high quality and well established questionnaire batteries and measurement scales (Blumberg *et al.* 2005, Saunders *et al.* 2009). Burns and Burns (2008) advice that internal validity of a study can be achieved through the use of existing quality questionnaires and measurement scales. Where new questions were developed, they were based on a detailed review of the relevant literature. In some instances, existing measurement scale items were modified to suit the research problem under investigation.

The use of multi-item scales: This approach ensured that dimensionality and internal consistency was achieved (Hair *et al.* 1998). Once again the use of established measurement scales ensured that dimensionality and internal consistency of the constructs were achieved. Factor analysis ensured that items measuring specified constructs were in effect measuring what they were expected to measure and as such content validity was ensured. Burns and Burns suggest that internal consistency can be measured by assessing the commonness of a set of items that measure a particular construct. Cronbach's alpha method was used to ensure that the multiple scales created in this study were internally reliable (Brace *et al.* 2009).

3.8. Research timeline

This research project was undertaken between October 2009 and July 2012. The major phases and stages in the research project are presented in figure 3.1.

Start of research	October 2009
Completion of main literature review/model design/research design	to September 2010
Confirmation and transfer to PhD	September 2010
Phase 1: Pilot qualitative study	June - October 2010
Phase 2: Draft questionnaire development	August – November 2010
Pretest of questionnaire	November – December 2010
Review of pretest questionnaire, selection of sample	November 2011– January 2012
Postal questionnaire survey	February – March 2011
Data cleaning, data analysis and results write up	April – December 2011
Write up draft chapters	November 2011 – April 2012
First draft	May 2012
Second draft	May 2012
Third draft	June 2012
Submission	July 2012

Figure 3.1: Research timeline

3.9. Chapter summary and link to chapter 4

This chapter presented the research design and methods used in this study. The research approaches in the social sciences were discussed and the sequential quantitative approach chosen for the study was discussed showing its strengths and limitations. In this direction, an inductive pilot phase was discussed which involved face to face interviews with seven farmers. The pilot phase led to the design of the questionnaire to be used in the quantitative phase of the study. The draft survey instrument was subject to a pre-test to ensure face and

content validity. The pre-test was administered by visiting the seven pilot survey participants and requesting that they complete the draft proforma under my supervision, voicing any concerns they might have about what appeared to be confusing or ambiguous terminology in the questions and/or skip instructions. The questionnaire was also reviewed by researchers at UWBS, Warwick Business School and Manchester Metropolitan University, and the NFU. Relevant comments and feedback were integrated into the questionnaire including reduction of the number of pages from 8 to 6. Systematic random sampling was used to draw a sample of 2,000 farmers from a list of 5,111 active members of the NFU West Midlands Region. The timing of the survey was critical to ensure that respondents had the time to complete the survey. The use of a non-financial incentive, endorsement by the NFU, reminder letters and email follow were necessary strategies put in place to increase response rates. Out of the 1960 questionnaires effectively delivered, 421 questionnaires were returned by the cut-off date. After checking for incomplete responses, 393 questionnaires were retained for further analysis representing a response rate of 20.1% which was considered adequate in this type of research.

The data collected was recorded in SPSS version 16 and prepared for further analysis. Non-response bias is a serious problem in postal surveys which can distort results. For this reason non-response bias analysis was undertaken by comparing early and late respondents on a number of personal and farm business characteristics. The analysis confirmed that non-response bias was very minimal in this study because late and early respondents differed only by gender. To ensure representativeness, the sample was compared to farm business 2010/2011 survey samples and DEFRA 2009 June Farm Business Structure survey statistics for the UK. Representativeness analysis confirmed that the sample was representative based on farm type, gender, type of tenure, age or respondents, and farm business size. Given that random sampling was used, an acceptable response rate was achieved, non-response bias was minimised and representativeness achieved, results of this

study can be generalised to the national situation. Principal component analysis and internal reliability analysis using the Cronbach alpha method confirmed that the constructs developed in the study were appropriate. Simple bivariate and more complex multivariate data analysis techniques were employed after ensuring that the necessary statistical assumptions were met. All of these factors ensured the validity and reliability of the research designed used in this study. In the following chapter, the research results and findings are presented in chapter 4.

Chapter 4: Results and analysis

4 Introduction

This chapter presents results of the postal questionnaire survey of farmers in the West Midlands Region of the UK as described in chapter 3. This chapter is organised into four main parts in line with these objectives. Part one presents information about the study participants and their businesses. The second part provides results of analysis covering the first to the fourth study aims. Part three of this chapter serves as an introduction to part four presenting descriptive information about adopters and non-adopters of RE enterprises and how they differ based on their resource base, their perceptions of the institutional environment and on their intentions towards investing in RE ventures. Part four then focuses on the results of multiple regression analysis that was carried out to test the RE investment intentions model developed in 2.8.4 and the hypotheses found in 2.8.5 addressing the factors which influence farmers' intentions to invest in RE enterprises.

Chapter 4: Part I

4.1 Survey participants and farm business resource characteristics

Section 7 and 8 of the questionnaire (appendix 3) was designed to collect background personal information about the respondents. This made it possible to have an insight into the farmers' situation/capacities with potential to affect behaviour. Respondents were asked to provide information about their gender, age, years of experience in agriculture, educational attainment as well as additional training received. Respondents were also asked to provide information about the farm businesses: farm types, farm area, farm ownership status, tenure, agricultural incomes, contribution of agriculture to farm business income, evolution of farm incomes in the past five years and the degree of diversification on the farm. This section presents descriptive statistics about these characteristics in the form of frequency distributions.

4.1.1. Gender

Question 8.1 asked respondents to report on their gender. The male and female respondents in the study comprised of 90% and 10% male and female respectively – see table 4.1. Looking at earlier studies on farm business development and adoption of energy crops in the UK (Carter, 1998, Sherrington and Moran, 2008), it appears that females were slightly more represented in this study. As the intention was not to assess the influence of gender on entrepreneurial behaviour, further analysis using this variable is not pursued in this research.

Table 4.1: Distribution of study respondents by gender

Gender	Observations	%
Male	334	90.3
Female	36	9.7
Total	370	100.0%

4.1.2. Age

When farmers were asked to choose the age category to which they belonged in question 8.2 of the questionnaire, it was found that less than 12% of respondents were below the age of 44 while the highest proportion (more than 50%) were aged over 55. Another 28% of the respondents said they were aged between 45 and 55 as shown in table 4.2 below.

Table 4.2: Distribution of respondents by age

Age	**N**	**(%)**
Less than 35	12	3.1
35 - 44 years	32	8.2
45 - 54 years	109	27.9
55 - 64 years	129	33.0
65 years and over	109	27.9
Total	391	100.0

Cumulative data from question 8.3 in the questionnaire shows that the majority of respondents had 25 years of experience in agriculture (88%). Table 4.3 shows that just over 1% of respondents were new to agriculture with less than five years of experience. It can be said therefore that respondents in this study were very likely to be knowledgeable about agriculture given that about 99% had experiences of at least five years or above. Age was found to be highly significantly correlated with years of experience in agriculture. Given the significant relationship between age and years of experience in agriculture, the latter will be used in regression analysis as a proxy for age.

Table 4.3: Distribution of respondents by years of experience in agriculture

Years of experience	N	%
Under 5 years	5	1.3
5 - 14 years	13	3.4
15 - 24 years	29	7.7
25 years and over	331	87.6
Total	378	100.0%

4.1.3. Educational attainment

Table 4.4 shows that most of the respondents (62%) had secondary level qualifications compared to 29% with university level qualifications. The results also show that 5% of respondents had not undertaken any formal education. Comparing educational attainment of farmers with that of other sectors, Gasson (1998) suggested that farmers are often poorly qualified.

Table 4.4: Distribution of respondents by levels of educational attainment

Educational status	**N**	**%**
Below secondary	14	3.7
Secondary	238	62.1
University degree	93	24.3
Postgraduate degree	19	5.0
Not undertaken formal study	19	5.0
Total	383	100.0%

4.1.4. Farm type

Lowland livestock grazing was the most prevalent farm type (22.4%) followed closely by cereals farms (21.7%). Table 4.5 shows that mixed (14%) and dairy (12%) were more prevalent than Grazing livestock (LFA) (8.4%) and general cropping (7.8%). According to

the Farm Business Survey (2011) the West Midlands Region is dominated by livestock as shown by the sample results.

Table 4.5: Distribution of respondents by farm type

Farm type	N	%
Cereals	140	21.7
General cropping	50	7.8
Horticulture	31	4.8
Specialty pigs	7	1.1
Poultry	21	3.3
Grazing Livestock (LFA)	54	8.4
Grazing livestock (lowland)	144	22.4
Dairy	80	12.4
Mixed	90	14.0
Other	27	4.2
Total	644	100.0%

The other farm types such as horticulture, poultry, specialty pigs made up 14% of the remaining occurring farm types.

4.1.5. Farm business size

Table 4.6 shows that the distribution of farm sizes was skewed towards large farms. Of all the five farm size categories suggested in question 7.2 of the questionnaire, the majority of respondents had farm sizes ranging from a hundred hectares and above followed by those with sizes ranging from 50-100 ha (27%). Farm sizes below 20 ha accounted for 12% and those between 20 and 50 ha for just over 14% of the farm area categories identified. Compared to DEFRA 2010 figures, farm sizes ranging from below 5 ha to 100 ha were more represented in this survey while farm sizes above a hundred hectares were underrepresented.

Table 4.6: Distribution of respondents by farm size

Farm size	N	%
Under 5 ha	10	2.6
5-20 ha	35	9.0
20-50 ha	55	14.2
50-100 ha	104	26.8
100 ha and above	184	47.4
Total	388	100.0

4.1.6. Farm ownership status

In response to the question on the farm ownership status, 25% said they were sole proprietors, 64% said they operated as family partnerships while 2% reported that they operated the farm business in partnership with non-family members while another 9% reported that the farm business was registered as a limited company. These results are largely in line with those obtained in the Cambridgeshire area by Sara and Rosa (1998) who found 53% partnerships, 25% sole traders and 21% limited companies. In other analysis, a single category has been created to include family and non-family partnerships given the low representation of non-family partnerships in the study.

4.1.7. Tenure

Table 4.7 shows that 79% of respondents had either wholly owned (46.9%) or mainly owned (32.2%) farms. Another 11.1% operated mainly tenanted premises while 9.8% of respondents stated that their farm business areas were wholly tenanted. The results are very similar to those reported by Maye *et al* (2009) from a sample of 3360 tenanted farmers drawn from 44,206 eligible tenanted landholdings in the UK. Tenure is often neglected in studies of the drivers of diversification in the UK farm sector. In effect, according to

DEFRA, 28% of holdings and 35% of agricultural land in the UK is cultivated under some form of tenancy agreement (Maye *et al.* 2009).

Table 4.7: Distribution of respondents by type of land tenure

Tenure	**N**	**%**
Wholly tenanted	38	9.8
Mainly tenanted	43	11.1
Mainly Owned	125	32.2
Wholly owned	182	46.9
Total	388	100.0%

4.1.8. Agricultural business turnover in 2009

Results showed that 29% of respondents had agricultural business turnovers under £50,000 in 2009 while 15% reported business turnovers between £50,000 – 99,999. A majority of farmers reported turnovers of above £100,000 with the highest proportion being between £100,000 -499,999 (36%). There was a significant relationship between farm size and agricultural business turnover (Kendall's tau_b= 0.52, p= 0.000). When respondents were asked to indicate the contribution of agriculture to family income, more than 50% of respondents indicated that agricultural contributed 75% of their family incomes. On the question relating to the profitability of the farm business in the past five years, 64% of respondents said they had made moderate profits. Just over 6% reported significant profits. Less than 10% of farmers reported moderate to significant losses on the farm business. This is interesting as it suggests that the case of economic non-viability of agricultural enterprises may often be overstated (Argiles, 2001).

4.1.9. Diversification activities

Table 4.8 shows that of the 366 responses obtained from question 7.8 of the questionnaire, about 80% of the responses showed that diversification (in its widest sense) was a common feature amongst farmers in the West Midlands. In order to understand the prevalence of RE with regards to other forms of diversification, it is realized that the most prevalent type of diversification activity is agricultural contracting (20%) followed closely by RE production (15%). Accommodation and catering activities are the third most important diversification activity (14%) followed by leasing of agricultural buildings (11%). Non-agricultural contracting, food packaging and equine business were the least common type of diversification activity.

Table 4.8: Types of diversification activities undertaken in the West Midlands Region

Diversification activity	N	%
Agricultural contracting	73	20.0
No diversified activity	70	19.1
RE/energy crops	55	15.0
Accommodation or catering	53	14.5
Leasing agricultural buildings	40	10.9
Non-agricultural contracting	30	8.2
Food preparation and packaging	14	3.8
Equine related activities on farm	9	2.5
Other forms of diversification	22	6.0
Total	366	100.0%

Other forms of diversification (6%) were plastic recycling, fruit and cider production, freezer lambs, pedigree breeding cattle, conservation grazing, barley beef and seed grain processing. The types of diversification activity in which farmers engaged were related to a number of farmers' traits and farm business characteristics. Farmers with larger farm businesses (from 100 ha and above) than smaller hectarage farms were more likely to be engaged in agricultural contracting ($\chi 2$= 9.63, d.f= 4, 0.047) as well as the leasing of

agricultural businesses (χ2= 13.63, d.f= 4, 0.001). It may be that farmers with larger farm sizes have surpluses and are more likely to lease agricultural machinery and buildings to external businesses. Results also show that farmers with agricultural business turnovers of above a £100,000 were more likely than those with low incomes to engage in accommodation and catering (χ2= 8.04, d.f= 4, 0.045). In addition, they were more likely to have engaged in non-agricultural contracting (χ2= 8.73, d.f= 3, 0.033), food preparation and packaging (χ2= 10.23, d.f= 3, 0.017). Farmers with secondary level educational qualifications and above were more likely to be engaged in non-agricultural contracting (χ2= 19.13, d.f= 3, 0.001) and food preparation and packaging (χ2= 13.78, d.f= 3, 0.008).

Chapter 4: Part II

4.2. The deployment of RE enterprises in the UK farm sector

The first objective of this study was **to assess the level of deployment of RE enterprises on UK farms.** This was important following earlier reports suggesting that the rate of deployment of RE was very low in the farm sector. In fact, DEFRA (2012) recorded only 5,054 (5%) of farm holdings producing RE in the UK. Key studies have also lamented the low deployment of energy crops (Sherrington and Moran, 2008, Sherrington *et al.* 2010) and anaerobic digestion (Tranter *et al.* 2011) for example and the recent publication of the RE road map (DECC, 2011b) has further emphasised the role different RE enterprises have to play in meeting the country's economic, energy and climate change objectives. This section provides information about the level of adoption of RE production and associated enterprises on UK farms and the preferences farmers have for different RE options.

The following section presents results derived from data collected in section 5 of the survey proforma (see appendix 3). In the first instance, farmers were asked in question 5.1 to state whether they had adopted any form of RE enterprise. For all those who reported adoption, they were requested to write the date of adoption followed by a description of the sources of funding for the projects. Question 5.1d asked adopters to state the types of RE enterprises adopted while 5.1e asked them to indicate on a five point Likert scale (1= highly deteriorated to 5= Significantly improved) whether adoption of RE had impacted on farm business performance and how much this was in financial terms (5.1f). For non-adopters, three questions (section 5.2) were asked to understand their intentions towards RE and their strategic preferences regarding different RE technologies available for those interested in RE. Adopters and potential adopters were then asked to state their motivations for adoption. For non-interested farmers, they were asked to state their reasons for non-adoption.

4.2.1. The incidence of RE enterprises in the West Midlands Region of the UK

Of the 393 participants in the mail survey, 55 (14%) had adopted some form of RE enterprise compared to 338 (86%) non-adopters. It is the first study in the UK to report these levels of adoption. Farmers were asked to indicate when they set up these enterprises on their farms. Frequency distributions showed that the range was between a year and 20 years. The median period was three years. The aggregate adoption rate of adoption of 14% masks the level of take up of individual types of enterprises.

Figure 4.1 shows that solar was the most popular type of RE enterprise (30%) adopted followed closely by biomass boilers (28%) fired by either on-farm biomass or off-farm woodchip. In addition, 13% had wind turbines installed on farms. Other biomass related enterprises accounted for 40% of those adopted. The incidence of these enterprises was evenly spread with Miscanthus (9%), short rotation coppice (7%), combined heat power (9%), and woodchip/pellet production (9%). The least prevalent types of enterprise were anaerobic digesters adopted by only 4% of adopting farmers. Other types of enterprises suggested included hydro, ground source heat pumps, timber wood burners and forestry. Figure 4.1 throws more light on the disaggregated take up rates.

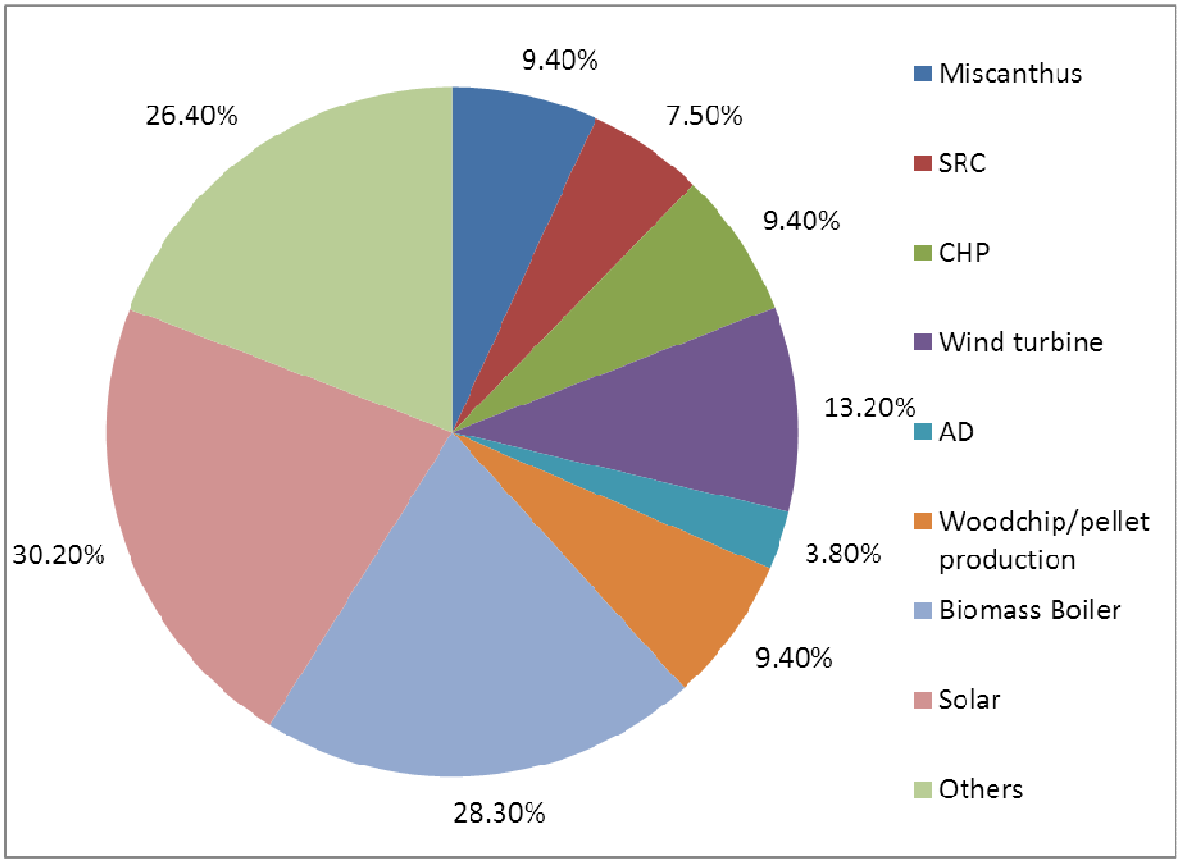


Figure 4.1: Types of RE production and associated enterprises adopted by farmers in the West Midlands of the UK

Note: Sum of percentages is above 100% because of multiple enterprises in some farms. 73 responses were obtained from the 55 adopters.

These results are interesting for the West Midlands region of the UK but how do they compare with national rates of adoption of RE enterprises reported by DEFRA (2012) based on June Census of Agriculture and Horticulture 2010. Table 4.9 provides this information.

Table 4.9: Level of adoption of RE technologies compared to the national situation

Renewable source	SAMPLE						DEFRA 2012	
	Before 2000	2000-2006	2007-2009	2010-2011	2011	%	holdings in 2010[12]	% adoption in 2010
Wind turbine	0	0	4	3	7	13	537	11
Biomass[a]	0	5	4	0	9	16	2,343	46
Biomass to produce biogas[b]	0	1	0	1	2	4	2,247	44
Solar	0	0	8	8	16	29	1,706	34
CHP	0	1	3	1	5	9		
Woodchip/pellet	0	2	2	1	5	9		
Production							933	18
Biomass Boiler	7	5	1	2	15	27		
Others	0	4	4	6	14	25		

a) Percentage based on number of adopters - Miscanthus (9%) and willow (7%)
b) DEFRA classification includes slurries, food and plant waste but not anaerobic digestion (4%) as in this study

Table 4.9 shows that the level of incidence of wind and solar energy production on farms in the West Midlands was similar to results obtained by DEFRA (2012) while biomass production was low compared to national figures. Because of differences in the classification used by DEFRA (2012) comparisons with the sample are difficult to make. Table 4.8b also shows that most of the solar and wind enterprises were set up between 2007 and 2010. It is likely that the introduction of the FITs in 2010 and the RHI in 2011 could be responsible for this result. The table also shows that the adoption of biomass crops occurred between 2000 and 2009 which if the likely effect of the Natural England energy crop schemes (Natural England, 2009).

[12] DEFRA (2012): Farming statistics diversification and renewable energy production on farms in England 2010, email: farming-statistics@defra.gsi.gov.uk

Adopters were asked to report the sources of their investment capital. Results indicate that 38% of current adopters used personal savings while 34% obtained funds from farm business reserves. Only 7% of current adopters had access to any form of bank assistance with about a 16% of respondents indicating that they had benefitted from government financial support. Considering the high initial outlays involved in setting up RE enterprises, it may be an indication of the conviction farmers had about the potential contribution to economic and non-economic goals. Only two out of the 55 adopters suggested that they obtained financial support from family to set up the enterprise. It is interesting to note that no mention was made of joint ventures or venture capital funds as source of capital. Further analysis suggests that only farmers with 100 ha and above were able to access bank credits. It appears that this category may be viewed as being more credit worthy than farmers with lower farm areas.

There was a significant difference between farmers as concerns the source of investment capital. For example, the use of personal savings (χ^2= 13.252, d.f = 4, p- two tailed= 0.010) business funds (χ^2= 15.549, d.f = 4, p- two tailed= 0.004) and other sources of capital (χ^2= 13.021, d.f = 4, p- two tailed= 0.011). Farmers operating farm businesses between 50 and 100 ha (38.50 %) were more likely to use personal savings than farmers with farm sizes less than 5 ha (3.80%). Farmers (78%) operating on a 100 ha and above were more likely to have accessed business funds to invest in the RE enterprises. In addition to the larger farm sizes, the farm business was also likely to be a family partnership, operating on a mainly or wholly owned farm land with annual farm business turnovers of above £100,000. Farmers obtaining financial resources from business were more likely to be between the ages of 45 and 54. No farmer below the age of 35 obtained funds from banks, subsidies or from business to invest in RE. Looking at access to government subsidies, the majority of respondents had farm sizes above 100 ha, operated family partnerships or operated on mainly owned lands. Worthy of note is that access to bank credit was also

influenced by a higher level of education of the farmer. Interestingly, only farmers with less than 5 ha reported using other types of capital including support of family. It appears from this analysis that a farmer's resource base is an important influence on the kind of financial resource that the farmer can access.

4.2.2. Motivations to invest in RE in the UK Farm Sector

Adopters and potential adopters were asked to report four most important reasons for investing in RE enterprises. The cumulative results are presented in figure 4.2. The figure shows that the main objective was to cut farm business costs (20.40%) closely followed by the need to diversify farm incomes (20.10%). The third most important motive was to take advantage of grants and subsidies (18.10%) while the fourth main reason was to exploit market opportunities (16.7%) in the RE sector. Farmers were less motivated by the need to achieve government targets or to provide environmental benefits from their activity. While RE enterprises can help manage agricultural waste, very few respondents would engage in this activity only for this sole reason.

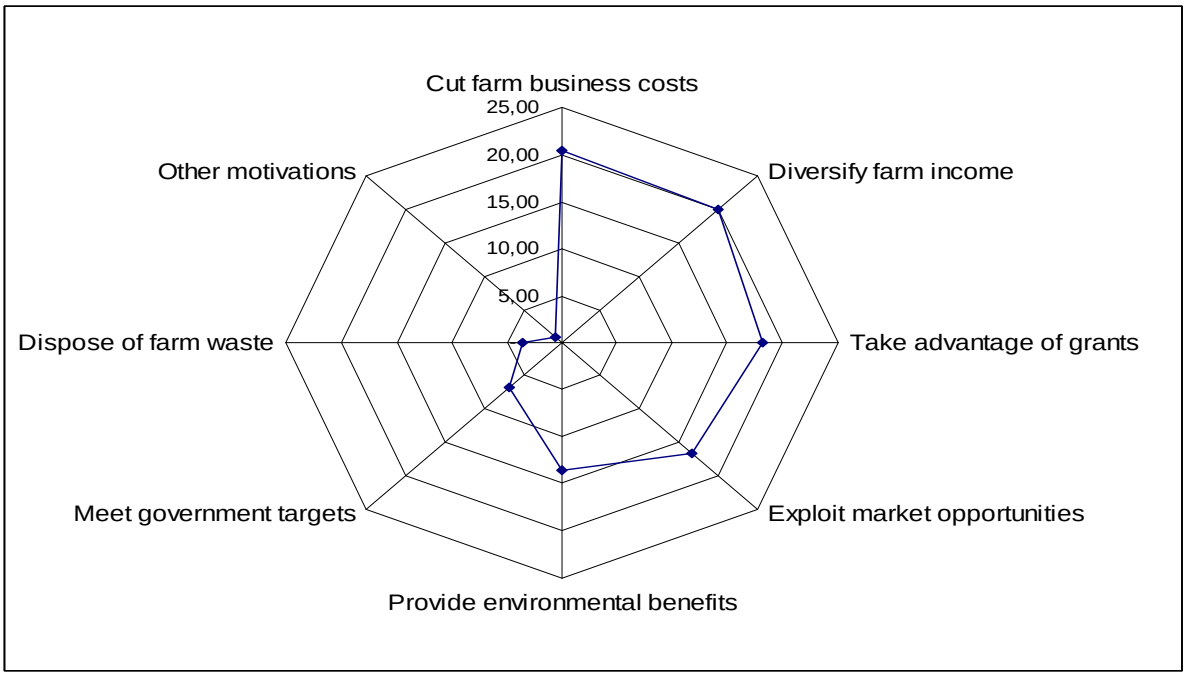


Figure 4.2: Motivations for adoption of RE enterprises

When these motivations are broken down for current adopters and potential adopters, a few differences emerged. “To cut farm business costs and diversify farm incomes” were the most popular reasons why adopters and non-adopters alike invested/would invest in RE enterprises with 40% stating that these were the most important. This represents the underlying understanding that RE could contribute to farm business performance. For current adopters, the third most important driver for adopters was the need to provide environmental benefits such as reducing CO_2 emissions, reducing fossil fuel dependency, providing clean air and reducing the impacts of climate change. It may be that earlier adopters of these enterprises had more environmentally friendly values. Table 4.10 below breaks down the motivations for adoption of RE enterprises.

Table 4.10: Reasons for adoption of RE enterprises

Motivation	Adopters		Non-adopters	
	N	%	N	%
To cut farm business costs	34	19.9	208	20.5
To diversify farm income	34	19.9	204	20.1
To provide environmental benefits	29	17.0	132	13.0
To take advantage of market opportunities	26	15.2	172	16.9
To take advantage of grants/subsidies	25	14.6	190	18.7
To help meet government targets	15	8.8	65	6.4
To dispose of farm waste	5	2.9	38	3.7
Other motivations	3	1.8	6	0.6
Total	171	100.0	1015	100.0

Taking advantage of government grants and subsidies was the third most important motivating factor for potential adopters. Investment outlays for RE enterprises are often very high and represent an important barrier for investment. As it has been reported, this

means that small and resource constrained farmers may be limited in their ability to invest in the absence of external grant support.

The fourth driver for adopters and non-non-adopters alike was the expectation to derive benefits from the emerging RE market. Less than 10% of current adopters were motivated by the intention to assist government meet targets. Anaerobic digestion and biomass heating may help farmers deal with farm waste or to meet environmental requirements (managing levels of nitrates, farm emissions) but the results show that less than 3% were interested in this type of enterprise. Results in this section show that investment decisions are guided by entrepreneurial motives as a means to improve the viability of their enterprises through a diversified market. The low interest in AD is of concern as it is one of the 8 most important RE technologies identified by the (DECC, 2011b) to assist achieve economic, energy and climate change targets. Other motivations reported were to make use of existing resources of the farm (3), to be seen as environmentally friendly (2), to prepare for retirement (1), to ensure long term financial security (2) and to safeguard against energy inflation (1)

4.2.3. The contribution of RE to Farm Business Performance

On the question of the contribution of the RE to farm business performance, 44% responded that performance had remained the same. The majority (52%) of current adopters reported slight to significant improvements in farm business performance in 2009 as shown in figure 4.3. Farmers setting up their enterprises between 2008 and 2009 were more likely to report stability in farm business performance or deterioration given the high levels of initial outlays involved. It is possible that at the time of the study the benefits were not already accruing from the enterprises to compensate for the initial investments.

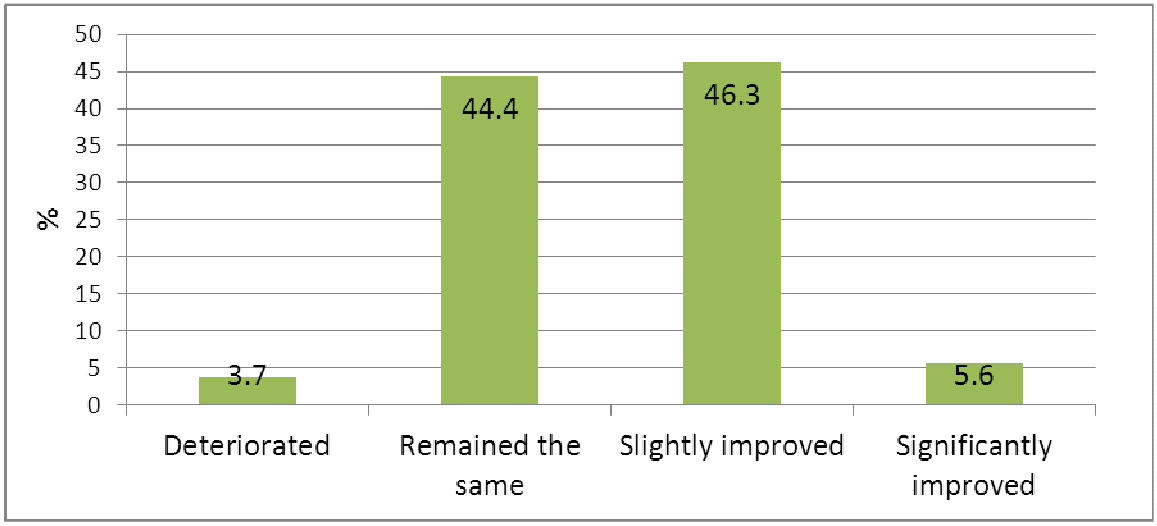


Figure 4.3: Extent of contribution of RE to farm business performance

However, when asked about the financial implications, up to 24% were unsure of the financial value of the contributions brought about by RE. Up to 35% of respondents reported incomes of between £1- £10,000 while another 2% suggested that the contribution of RE could be estimated at above £25,000 turnover in 2009. It is important to note that there is a disparity in the figures relating to farmers' perceptions regarding the contribution of RE to farm business performance (fig 4.3) and the objective reports relating to the financial contribution (fig 4.4). The fact that up to 24% were not sure about the financial contribution leads to the view that farm book keeping might be inadequate. It may also be that farmers were more likely in figure 4.3 to demonstrate that investment had been worthwhile meanwhile in reality, they did not have sufficient evidence to back up the point. It is therefore important to ascertain the real financial and economic value of the enterprises on farm business performance. This is an interesting area for future research.

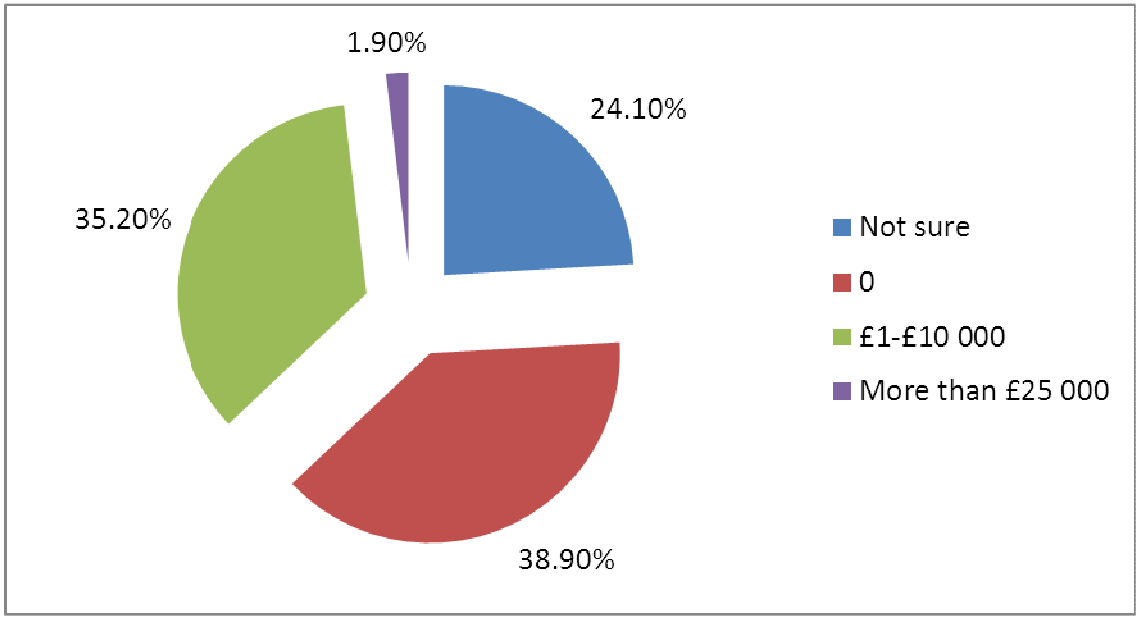


Figure 4.4: Estimated financial contribution of RE to farm business performance

4.2.4. Constraints to RE deployment in the UK farm sector

Question 5.4 was an open ended question to collect information about constraints to investment in RE. Farmers were asked to state what they considered the three most important barriers or constraints to adoption or to the expansion of existing RE on their farms. A total of 193 barriers were reported and were entered into an excel spread sheet. To facilitate understanding of the responses, they were grouped into 3 broad categories:

(i) Economic;

(ii) Institutional/Cognitive,

(iii) Normative/social acceptability constraints.

It is important to highlight that these constraining factors are not absolute implying that they can be improved in order to achieve RE objectives.

4.2.4.1. Economic barriers

Out of the 193 individual items reported, ninety one of them barriers were identified as being of economic nature. Figure 4.5 shows that almost 40% of the barriers identified in this category related to the high costs required to set up RE enterprises in general. The

figure also shows that 15% of the responses concerned the suitability of the farm to integrate the new enterprises. Key issues were related to small farm sizes, inadequate financial resources, weak roof tops (for solar) and location (not enough wind speeds…).

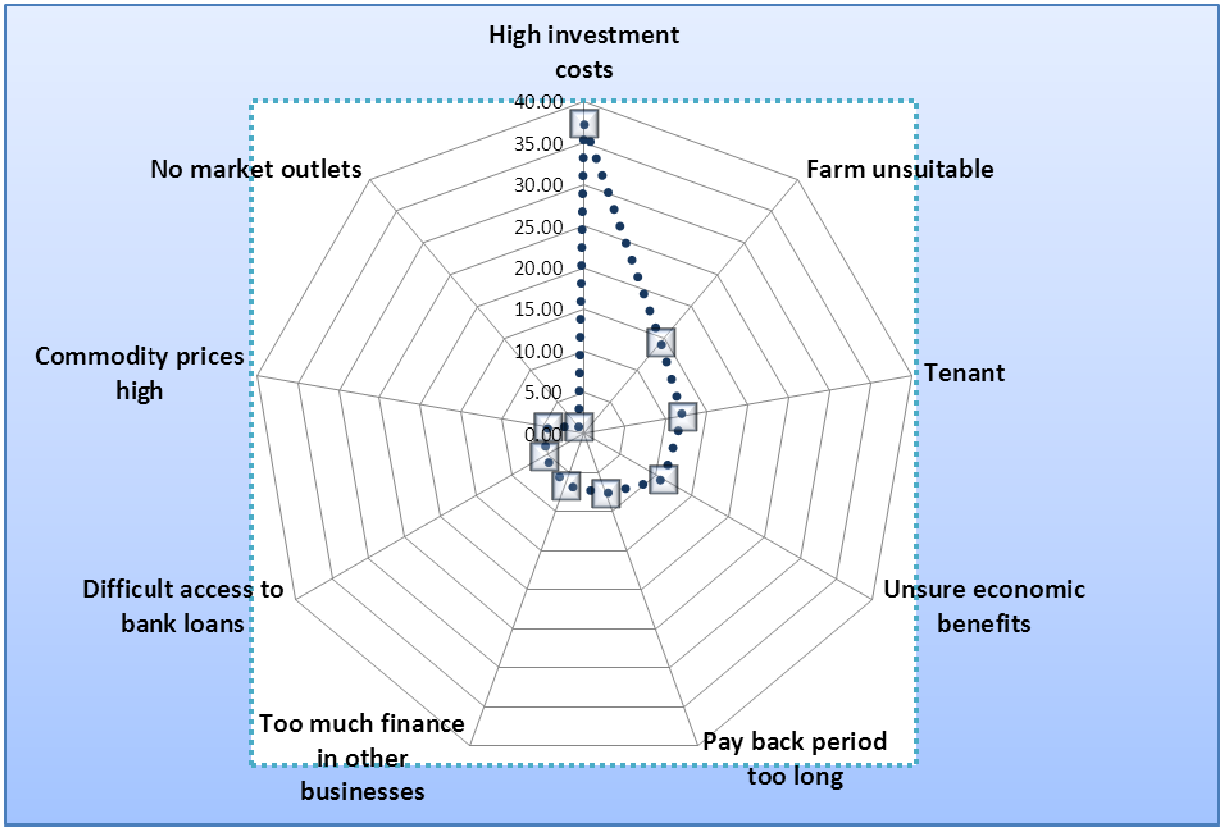


Figure 4.5: Economic barriers to investment in RE

The type of tenancy/land occupation was the third most recurrent barrier. This was most likely to be raised by farmers on part/wholly tenanted farms. This may suggest that even when farmers on such holdings are willing to engage in the activity, their tenancy agreements might not readily be supportive of their intentions. Interestingly, unsure economic benefits and pay back periods were only the fourth and fifth most important constraints identified. Such results may indicate that farmers are aware that the payback periods are longer for these types of enterprises and that if the initial investment barriers are surmounted, they can as well deal with the extended spread of returns from the enterprises. Given that only a few barriers related to high commodity prices and market outlets were highlighted may suggest that respondents thought there were market opportunities to be exploited. It has often been argued that there might be a backlash on

energy crops if commodity prices go up (Ericsson *et al.* 2009). The idea being that farmers would be disinterested to commit large surfaces to energy crops when other traditional enterprises are more favourable.

4.2.4.2. Institutional/cognitive barriers

Out of 193 responses, 45 of the items were related to institutional and informational barriers. Figure 4.6 shows that most farmers considered planning to be an important impediment in the adoption process. Close to 40% of the responses highlighted planning as the most important barrier followed by administrative barriers. In effect, cumbersome and costly planning processes are transaction costs which potential investors have to overcome before setting up their enterprises. It is unlikely that resource constrained farmers will be able to overcome these transaction costs further limiting their abilities to engage in this type of enterprise.

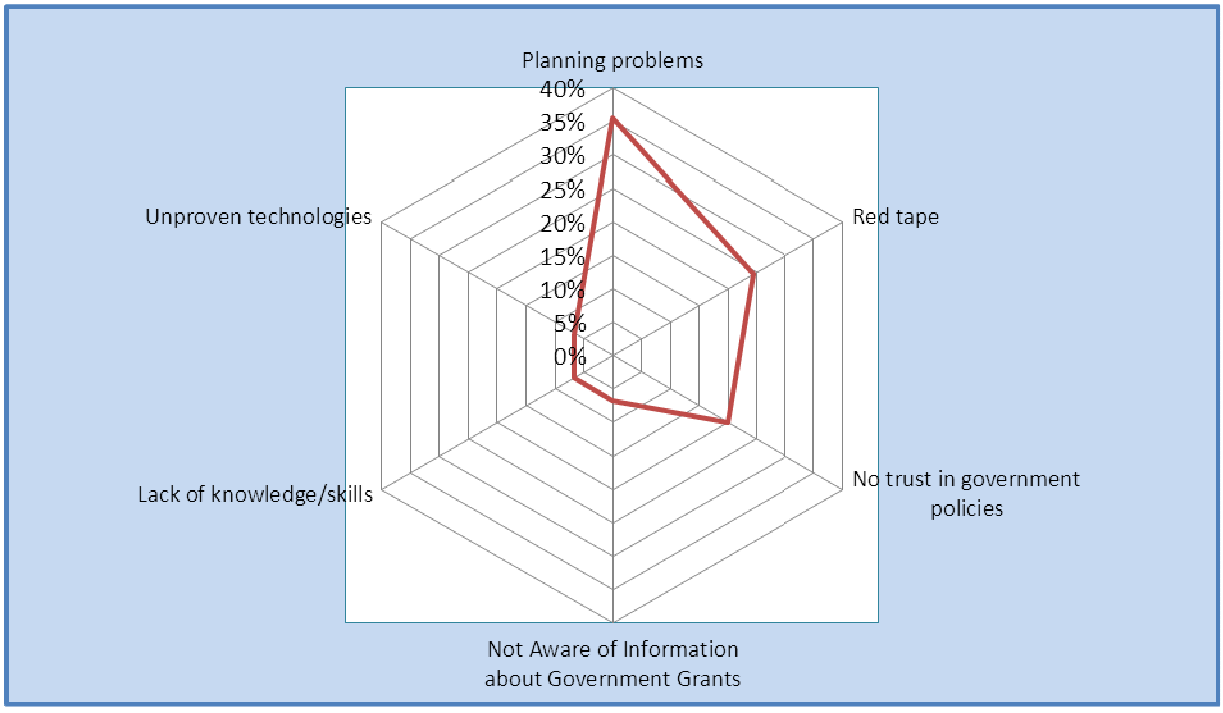


Figure 4.6: Institutional and cognitive barriers to investment in RE

In addition, there were concerns about red tape and uncertainty regarding government policies. While the issue of red tape relates to the planning problems, the issue of lack of

trust means that farmers consider the policy framework to be unstable therefore creating a risky business environment. Given that long financial maturity periods/payback periods of most RE enterprises, unstable policies mean that investors are not sure whether investment outcomes would be positive and whether support structures will continue to provide assistance in the medium to long term. This concern is understandable because government RE policy has tended to change too often in the UK (Slade *et al.* 2009).

There were only nine barriers related to know-how, technology and information about grants. Even though these represent only 10% of the overall responses, they are an indication that there are still problems to be solved in these areas to boost adoption. Farmers need consistent information about these new enterprises. A key issue which emerged from further analysis was that farmers considered information about RE to be largely conflicting. According to figure 4.7, about 70% of respondents in the study thought that information about RE was largely incoherent.

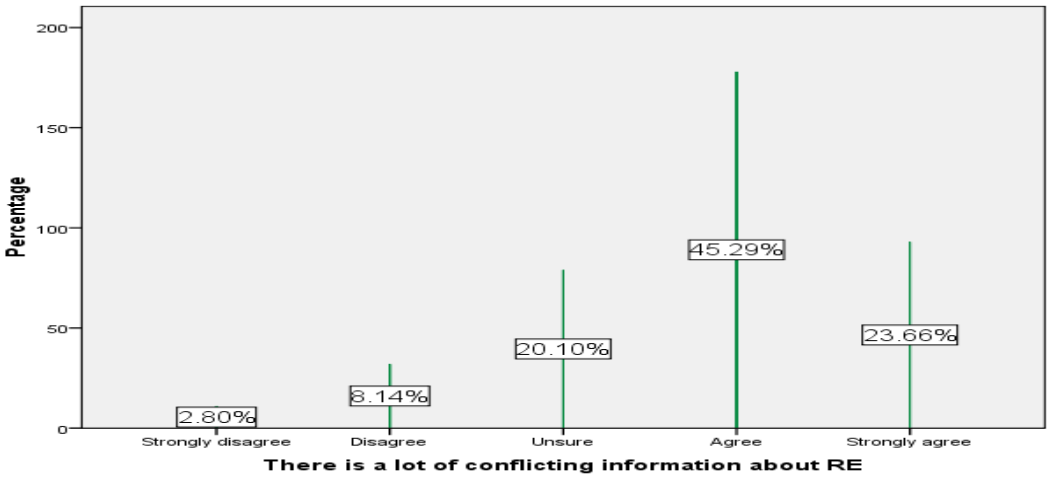


Figure 4.7: Perceptions of the coherence of RE information

4.2.4.3. Normative/social acceptability barriers

Figure 4.8 shows that social barriers were more of personal concern regarding age, labour requirements, succession and interest. Up to 40% of the responses gathered indicate that

age was an important concern to many respondents affecting the decision to invest in RE production or its associated enterprises.

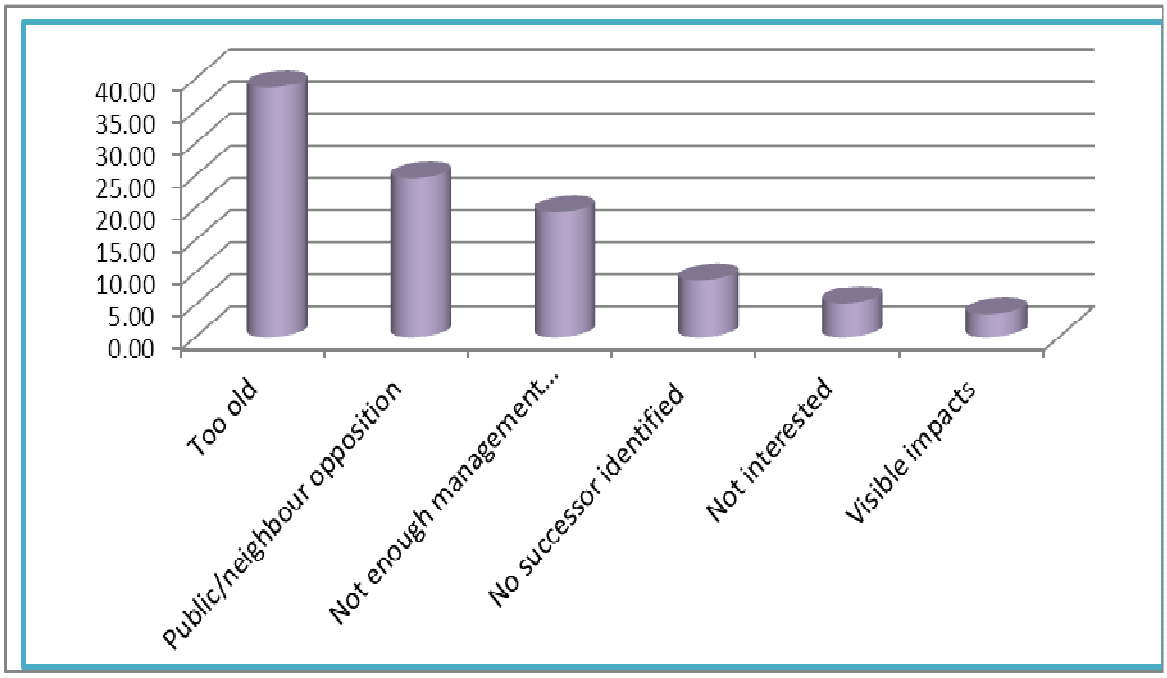


Figure 4.8: Normative/social acceptability barriers to investment in RE

The concern about labour requirements was raised mainly by dairy and younger farmers particularly those with higher levels of education. As suggested earlier, farmers are less likely to invest in enterprises that substantially increase their labour inputs. Social acceptability barriers were the second most important barriers identified (public/neighbour opposition and visual impacts).

4.2.5. Strategic interests of potential adopters

Investors have strategic preferences with regards to RE investment options (Wüstenhagen and Menichetti, 2012). Most of the available research on the issue of RE adoption is often stated as involving a choice between investment in RE and investment in traditional agricultural enterprises (Rosenqvist and Dawson, 2005, Clancy *et al.* 2011). The conclusion often reached in these studies is that farmers are less likely to invest in RE if the potential returns are lower than those from traditional farm enterprises. These studies are often limited as they seek to compare a specific RE option for farmers without

considering the preferences farmers may have regarding other types of RE enterprises. This section throws more light on farmers' strategic preferences regarding different RE options. Information presented in figure 4.9 was collected from sections 5.2d of the data collection questionnaire where current non-adopters were asked to report their investment preferences with regards to RE ventures.

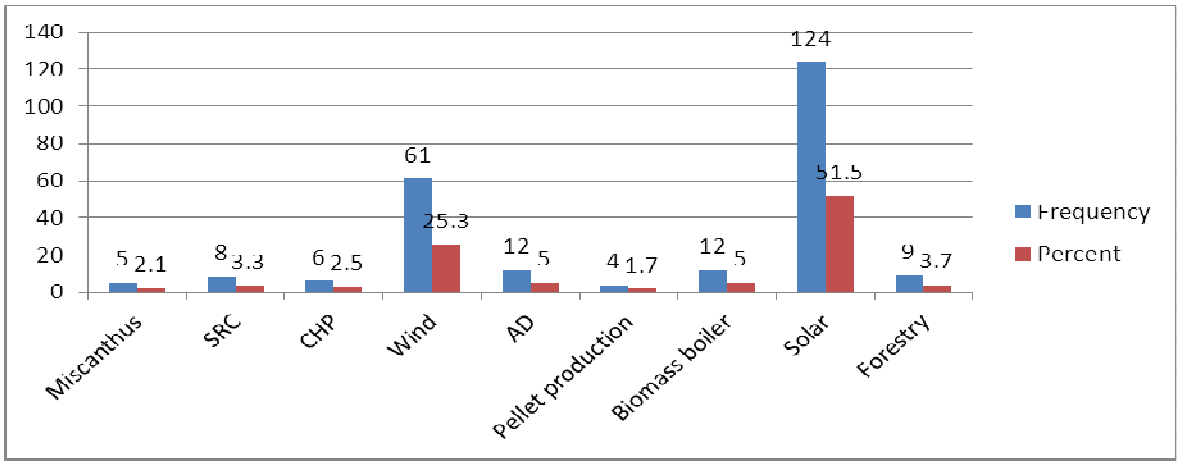


Figure 4.9: Types of RE enterprises of interest to potential adopters

Interestingly figure 4.9 shows that farmers' preferences are biased towards solar and onshore wind energy production. The figure shows that 52% preferred to set up solar energy systems followed by 61 others interested in wind energy production (25%). These results are broadly supportive of earlier findings from this survey which showed that solar, biomass boilers and wind were the most prevalent enterprises adopted. The results immediately reveal weaknesses in studies which define the types of enterprises that are of interest to the farmer before carrying out the study. In addition, no study has compared investment in wind/solar compared to traditional agricultural enterprises. The results show that biomass related enterprises make 23% of enterprises that are likely to be developed. These enterprises are: Miscanthus (2.1%); short rotation coppice (3.3%); combined heat power (2.5%); forestry (3.7%); biomass boilers (5%) and pellet production (1.7%), AD (5%). Breaking down these results shows that energy crops and pellet production are the

least likely to be adopted which immediately cast doubts on government policy objectives with regards to the potential contribution of biomass related enterprises to achieve energy and climate change objectives (DECC, 2011b). Based on results obtained in this study, it is very unlikely that energy crop production for example will take off unless the barriers to investment identified can be surmounted. Sherrington and Moran (2008) identified farm specific constraints for energy crop deployment in the UK raising issues about investment costs, payback periods, inflexibility of the enterprises, disruptions to cash flows, contracting and inadequate policy incentives. It is also interesting to see that there is higher interest in anaerobic digestion than was the case for existing adopters. Anaerobic digestion has been highlighted as one of the most important RE options to green the economy (DECC, 2011a). The next subsection part 3 of this chapter presents descriptive statistics regarding the underlying differences between adopters and non-adopters.

Chapter 4: Part III

4.3 The Influence of the farmer/farm resource base on RE adoption decisions

The aim of this section is to present further analysis of the descriptive results presented in section 4.2. The objective is to understand whether there are any significant underlying differences between adopters and non-adopters of RE based on their farm resource base. An initial chi square test showed that there were indeed significant differences between adopters and non-adopters (χ^2= 203.78, d.f= 1, two tailed p= 0.000). Further analysis was carried out to identify the underlying reasons for the differences.

In the first instance, attention was laid on the farmers' traits and farm business characteristics. The farmer traits considered were age, years of experience in agriculture and levels of educational qualification, while business characteristics included farm size, agricultural turnovers, tenure, farm ownership status and farm type. Adopters and non-adopters were considered to be unrelated samples and guidance was obtained from Bryman and Cramer (2008) on the appropriate statistical test to use. For ordinal level variables, Mann-Whitney U tests were performed while chi-square tests out on nominal level variables. Throughout this section, p values of 0.10 are also reported. This thesis proposed that more resourceful farmers/farm businesses with more resource bundles will be more adopters than non-adopters.

Secondly an evaluation was made of adopters and non-adopters' assessment of favourability of the institutional environment. The rationale was to find out whether adopters viewed the institutional environment differently from non-adopters? The last section analysed the attitudes of adopters and non-adopters towards RE and sought to find out whether there were any differences between adopters and non-adopters in their

attitudes towards RE enterprises. Independent t-tests were used to analyse for the differences because the institutional and attitudinal variables were considered to be scale/interval variables (Bryman and Cramer, 2008). All the variables used here showed adequate levels of internal reliability (table 3.9- 3.15 chapter 3).

4.3.1. Age

Academic literature on the adoption of agricultural innovations has often found mixed results regarding the role of age on innovation adoption (Jones, 2006). Taking adopters first, it was found that the 67% of farmers were aged 55 and above which is contrary to expectation. As expected, 80% of current non-adopters in our sample were above 45 years old suggesting that a negative relationship between adoption and age. Given the similarity in the age distribution between adopters and non-adopters a Mann Whitney U= 9140,500, p -2 tailed = 0.447 found no significant difference.

4.3.2. Educational attainment

A Mann-Whitney U-test showed that there was a significant difference in educational attainment between adopters and non-adopters (Mann-Whitney U = 6830, 500, p= 0.001). Study participants with higher levels of educational attainment were more likely to be adopters than non-adopters. Compared to adopters, there were far more non-adopters with secondary level education (65%) than university level education (21%).

4.3.3. Farm ownership status

Statistical analysis showed that adopters and non-adopters differed significantly by ownership status of the farm (χ2= 10.396, d.f= 3, 0.015). The highest rate of adoption took place on family partnered farms (51%), sole proprietorships (29%) followed by limited companies (18%) as shown in table 4.11. Partnerships operated in collaboration with non-family members showed the least interest in adopting RE. A similar trend is observed with non-adopters except that there were more non-adopters in the family partnership category

(66%) than for adopters. The farm business ownership status gives an indication of the level of complexity of farm management practices where sole proprietorships are considered to have the least complex decision making processes. This can also include limited abilities to mobilise external investment resources. It was found that none of the sole managed farms adopted high capital intensive enterprises like wind, willow, co-firing or woodchip/pellet production in contrast to family businesses and limited companies with possibly more resources.

Table 4.11: Farm ownership status and adoption

	Have you adopted RE		
Farm ownership status	Yes (%)	No (%)	Total (%)
Sole proprietorship	29.1	25.0	25.6
Family partnership	50.9	66.3	64.1
Partnership with non-family	1.8	2.4	2.3
Limited Company	18.2	6.3	8.0
N	55	332	387
Total	100.0%	100.0%	100.0%

4.3.4. Farm type

Table 4.12 shows that there were significant differences between adopters and non-adopters by farm type. It emerged that adopters were more likely to operate cereal farms (χ^2= 4.986, d.f 1, p= 0.013) than dairy farms (χ^2= 3.358, d.f 1, p= 0.028).

Table 4.12: Distribution of adopters and non-adopters by farm type

Farm type	Adopters %	Non-adopters %	χ^2	d.f	2 tailed sig
Cereals	30.7	20.3	4.986	1	0.013*
General cropping	9.1	7.6	0.181	1	0.334
Horticulture	6.8	4.5	0.791	1	0.187
Specialty pigs	1.1	1.1	0.000	1	0.492
Poultry	5.7	2.9	1.759	1	0.092†
Grazing Livestock (LFA)	5.7	8.8	1.182	1	0.134
Grazing livestock (lowland)	19.3	22.8	0.923	1	0.162
Dairy	6.8	13.3	3.358	1	0.028*
Mixed	9.1	14.7	2.256	1	0.055†
Other	5.7	4.0	0.484	1	0.243
Total = N	100.0	100.0			

Table 4.12 shows that there were 13% of non-adopters compared to 7% adopters operating dairy farms. Dairy farming tends to be labour intensive meaning that the opportunity costs involved in changing the enterprise mix to accommodate a new activity may be high reducing the likelihood to adopt potential enterprises. This suggests that there might be a negative relationship between the operation of dairy farms and investment in additional farm enterprises (Clancy *et al.* 2011).

4.3.5. Tenure

As expected, table 4.13 shows that there were more adopters operating mainly owned (33.3%) or wholly owned (53.7%) farms compared to 7.4% running mainly tenanted or wholly tenanted (5.6%) farms. This seems to show that control of the land resource is positively related to investment behavior. The distribution in tenure was broadly similar for adopters and non-adopters and statistical analysis did not show any significant difference between adopters and non-adopters (U= 8003, p= 0.232).

Table 4.13: Distribution of adopters and non-adopters by type of land tenure

Type of tenure	Have you adopted RE production on farm?	
	Yes	No
Wholly tenanted	5.6	10.5
Mainly tenanted	7.4	11.7
Mainly owned	33.3	32.0
Wholly owned	53.7	45.8
Total	54	334
	100.0%	100.0%

4.3.6. Farm business size

The distribution of adopters and non-adopters by farm size is presented in table 4.14. It shows that the distribution is fairly similar between adopters and non-adopters. For instance, 49% of adopters had farm sizes of a hundred hectares and above compared to 47% for non-adopters. A Mann-Whitney U test showed that there was no significant difference in farm size between adopters and non-adopters (U= 9087, p= 0.233 p-2 tailed).

Table 4.14: Distribution of adopters and non-adopters by farm size

Farm size	Have you adopted RE	
	Yes	No
< 5 ha	3.6	2.4
5-20 ha	7.3	9.3
20-50 ha	16.4	13.8
50-100 ha	23.6	27.3
100 ha and above	49.1	47.1
N	55	333
Total	100.0%	100.0%

This result seems to be contrary to the expectation that adopters would have larger farm sizes compared to non-adopters. In fact looking at the rates of adoption per category, the

results reveal that a greater proportion of adopters had farm sizes above 50 ha. Land is an important physical asset and helps in the development of new business opportunities. For example, it is used as collateral security to access credits from banks. Apart from facilitating access to loans, farmers with large farm sizes are able to derive threshold effects/economies of scale especially in the development of energy crop farms. A farmer needs to cultivate a certain number of hectares of energy crops to make the venture viable. What this means is that larger farm sizes provide more flexibility and scope for the incorporation of additional enterprises.

4.3.7. Summary of the effect of personal and farm business characteristics on RE investment intentions

Statistical analysis showed that there were significant differences between adopters and non-adopters of RE enterprises on farms. Firstly, there was a significant difference by level of educational attainment. More educated farmers were more likely to be adopters than non-adopters. Secondly, there were significant differences between adopters and non-adopters by farm type. Adopters were more likely to be cereal farmers while non-adopters were more likely to be dairy farmers suggesting that the intensity of the agricultural labour requirements on the farm were negatively related to adoption. Adoption of RE enterprises was most popular on cereal farms and on lowland livestock grazing farms. Biomass boilers, solar, wind turbines and Miscanthus were the most prevalent enterprises on cereal farms. Solar and biomass boilers were the most recurrent on grazing livestock (lowland).

Thirdly, significant differences were also identified related to the farm ownership/legal status. The highest rate of adoption was found on family partnered farms. Sole trader managed farms were the least likely to have adopted high capital intensive enterprises like wind, willow in contrast to more resource endowed farms.

No significant differences were observed between adopters and non-adopters by type of land tenure, farm size and agricultural business turnover. As concerns tenure however, there was a higher proportion of adopters operating mainly owned or fully owned farmers than non-adopters did. Farmers on wholly tenanted farmers were the least likely to adopt RE production or associated enterprises on their farms. It also emerged that a greater proportion of adopters than non-adopters had farm sizes above 50 ha.

4.4 Farmers' assessment of the favourability of the institutional environment

This section presents results of statistical analysis carried to find out whether adopters differed from non-adopters on their assessment of the favourability of the entrepreneurial environment for RE in the UK. The factors analysed included the regulatory, cognitive, and normative environment. To carry out the analysis, the independent t-test for unrelated samples was used given that the scale of the test variables were interval and parametric tests could be used (Brace *et al.* 2009).

4.4.1. Regulatory dimension of the country's institutional profile for the RE sector

Section 1 of the questionnaire collected data about farmers' assessment of the favourability of the regulatory institutional environment for RE development. Through factor analysis, two subscales emerged measuring regulatory support for RE and regulatory complexity involved in the process of setting up RE enterprises (see section 3.5 chapter 3).

4.4.1.1. Regulatory support for RE development

Table 4.15 shows results of the independent two sample t-test based on adopters and non-adopters assessment of regulatory support for RE. Looking at the mean assessments of adopters and non-adopters, table 4.15 shows that non-adopters thought the current regulatory environment was potentially more supportive than current adopters. This might

immediately seem to be contradictory but it may be an indication of the positive evolution of the policy framework for RE deployment in the UK. The UK policy framework has often been criticized as not being favourable for microgeneration particularly the lack of specific policy support for renewable heat.

Table 4.15: 2 Independent sample t-tests for adopters and non-adopters based on assessments of the favourability of regulatory support for RE

Regulatory support	Adopters (Mean)	Non-adopters (Mean)	Levenes test (F)	P	T-Value	2-tailed sig.
Government organisations assist farmers start RE	3.04	3.37	0.03	0.86	-2.41	0.016*
Government sponsors organisations that help farmers invest in RE	3.15	3.41	0.01	0.94	-2.02	0.044*
Current policies encourage farmers to adopt RE	3.38	3.39	0.13	0.72	-0.05	0.962
Local councils provide support to farmers to set up RE on farms	2.33	2.72	0.18	0.67	-2.77	0.006**
Government grants are available for farmers starting RE enterprises	2.80	3.15	3.42	0.07	-2.10	0.039*
Banks have funds available for farmers starting RE enterprises in the UK	2.67	3.04	16.37	0.00	-2.25	0.028*

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05

The publication of the RE road map (DECC, 2011b) as well as the introduction of the Feed in Tariffs (DECC, 2010a, Department for Energy and Climate Change, 2012) are all policy initiatives that seem to have been received positively by respondents leading to improved views about the supportiveness of the regulatory environment. It is probable that current adopters were more inclined to assess the favourability of the regulatory support

environment based on their experiences of the old RE policy regime. While most of the items were significantly different for adopters and non-adopters, no difference was found for responses to the question "current RE policies encouraged microgeneration of energy by farmers". Though statistical significant results are obtained, for the questionnaire item "local councils provide support to farmers to set up RE on farmers", the mean results (below 3.00) suggest that adopters and non-adopters alike consider council support to be insufficient.

4.4.1.2. Regulatory complexity for investment in RE

Another dimension of the formal policy framework affecting investments in RE relates to red tape and procedural requirements. No significant differences were found between adopters and non-adopters on this issue. The mean values for adopters and non-adopters were all below 3.00 providing support to the view that there was too much red tape and difficult procedural requirements for investment in RE. This represents a significant barrier for the development of RE in the UK. The development of this scale and its strong internal reliability suggests that research on RE policy frameworks needs to consider planning issues independently from overall government support (tax/credit incentives, subsidies…)

4.4.2. The country's cognitive institutional environment for the RE sector

Four items in section 3 of the questionnaire were used to elicit information about farmers' evaluation of the cognitive environment. The internal reliability α of 0.68 of the scale developed in section 3.5 chapter 3 was acceptable in view of Kostova and Roth (2002). Table 4.16 shows that there were no significant differences between adopters and non-adoptersas regards assessment of the munificence of the cognitive environment for RE development in the UK. The mean values for adopters and non-adopters reveal that farmers view the cognitive environment unfavourably (mean value of the scale below 3).

Table 4.16: 2 independent sample t-tests for adopters and non-adopters based on assessments of the favourability of the cognitive environment

Cognitive institutions	Adopters (Mean)	Non-adopters (Mean)	Levenes test of equality	P	T-Value	2-tailed sig.
Farmers know where to find relevant information about RE	2.98	3.00	1.94	0.164	-0.12	0.907
People in the UK know a great deal about RE	2.30	2.32	1.94	0.164	-0.11	0.900
Farmers are familiar with the different financial support packages available to them	2.44	2.55	0.51	0.474	-0.10	0.923
There are many training programmes for farmers on RE topics	3.00	2.93	0.00	0.962	-0.74	0.457

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

It was found that non-adopters were unsure about the availability of relevant information and training programmes on RE topics. Adopters and non-adopters alike said they were unfamiliar with the different financial support packages available to them (mean values below 3) and were also uncertain about the availability of information and skills development opportunities. A key challenge is therefore to improve the overall framework cognitive framework and make it more accessible and sensitive to the farmers' needs.

4.4.3. Normative institutional profile

Two constructs were developed to measure the effect of the country's normative institutional profile on RE investment intentions – social acceptability of entrepreneurship and support of family, friends and associational networks. The section presents adopters and non-adopters assessments of the favourability of these environments for RE development in the UK farm sector.

4.4.3.1. Social acceptability of entrepreneurship in the RE sector

Results in table 4.17 show that there was a statistically significant difference between adopters and non- adopters with regards to their assessment of the acceptability of entrepreneurship in the RE sector. Contrary to expectation, results from current non-adopters showed that they perceived entrepreneurship in the RE sector to be more socially acceptable than current adopters. Research has suggested that social acceptability of RE follows a U-curve and so it is likely to explain the differences in the view points.

Table 4.17: 2 independent sample t-tests for adopters and non-adopters based on assessments of the favourability of social acceptability of entrepreneurship

Social acceptability of entrepreneurship	Adopters (Mean)	Non-adopters (Mean)	Levenes test of equality	P	T-Value	2-tailed sig.
People in the UK tend to admire those who start their own businesses	3.22	3.65	0.11	0.739	-2.76	0.006**
Farmers with successful businesses are admired	3.05	3.24	0.15	0.698	-1.06	0.291

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05

4.4.3.2. Support of family, friends and associational networks

Support of significant referents has an important influence on farmers' decision makings. According to Baughn *et al* (2006a), social support for entrepreneurship including the support of family and friends reflect societal norms. When it comes to research on the factors affecting adoption of RE, this factor is often ignored or is considered to have little influence in the decision making process. Table 4.18 shows that there was no significant difference between adopters and non-adopters as concerns their assessment of the availability/access to support of family, friends and business networks. Considering that about 60% of the study respondents ran family partnership farms, this sort of result was to

be expected despite the fact that adopters rated the support of social networks a little bit more favourably than non-adopters.

Table 4.18: 2 independent sample t-tests for adopters and non-adopters based on assessments of the favourability of family, friends and associational network support

Support of friends, family and business networks	Adopters (Mean)	Non-adopters (Mean)	Levenes test of equality	P	t-Value	2-tailed sig.
My family has social relationships that can help my business	3.07	3.08	0.90	0.34	0.72	0.237
I have friends and family that can assist my business development	3.29	3.19	0.00	0.98	0.52	0.302
I have business networks that I can count on for help in case of difficulties	3.24	3.15	0.01	0.91	-0.00	0.459

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

4.4.4. Summary of the differences in perceptions regarding the favourability of the institutional environment

There were statistically significant differences between adopters and non-adopters with regards to the evaluation of the favourability of the institutional environment for RE deployment in the UK farm sector. Results showed that non-adopters rather than current adopters perceived the RE support framework to be more favourable for RE development. Regarding the influence of regulatory complexity involved in the process of setting up RE enterprises, no statistical significant differences emerged between adopters and non-adopters. However, there was agreement amongst survey respondents that procedural requirements and red tape was prevalent and would possibly affect adoption negatively. No significant differences were also found between adopters and non-adopters with regards to

their assessment of the favourability of the cognitive environment. Most of the mean values were below 3.0 suggesting that adopters and non-adopters viewed the environment as being unfavourable for RE development. The most important issue was the fact that most study participants did not know about the different financial support packages available to them.

Results showed that there was a significant difference with regards to social acceptability of entrepreneurship. Interestingly, non-adopters viewed the environment slightly more favourably than current adopters. This suggested that there might be increasing acceptance of entrepreneurship than has been the case in the past but the U-shaped nature of acceptability of RE (Wüstenhagen *et al.* 2007) means more research might be required to fully understand the reasons for the differences. On the subject of the normative support of family, friends and business networks, no statistical differences were observed in the responses of adopters and non-adopters. Overall, adopters and non-adopters considered that they would have support of social networks if they decided to invest in RE

From the findings, it emerges that respondents perceived the regulatory and cognitive institutional environments as being unfriendly and likely to impede take up of RE enterprises in the farm sector.

4.5 Attitudes towards entrepreneurship in the RE domain

An attitude refers to the personal predisposition of an individual to respond in a positive or negative way to a stimulus (Azjen, 1991). Section 6 in the data collection instrument was designed to collect data on farmers' attitudes towards RE enterprises. The questionnaire had 10 items to measure these attitudes. Results in section 3.5 chapter 3 showed that the scales produced had high internal reliabilities.

4.5.1 Perceived self-efficacy

All the results shown in table 4.19 are as expected. The mean scores for adopters were significantly higher than those of non-adopters as concerns perceived feasibility of RE ventures. This implies that adopters were more likely to report higher levels of confidence in their abilities to invest in RE.

Table 4.19: 2 independent sample t-tests for adopters and non-adopters based on assessments of their perceived self-efficacy

Perceived self-efficacy	Adopters (Mean)	Non-adopters (Mean)	Levenes test of equality	P	T-Value	2 tailed sig.
Identify new opportunities and act on them	3.75	3.46	3.13	0.078	2.06	0.043*
Find right technology that is needed for the farm	3.87	3.46	12.25	0.001	3.52	0.001***
Estimate financial viability of the RE enterprise	3.89	3.38	14.06	0.000	4.08	0.000***
Raise enough funds to start a RE enterprise	3.62	3.16	3.16	0.076	2.67	0.008**
Lead the planning permission process at local council level	3.05	2.78	0.63	0.428	1.61	0.109
Organise and maintain financial records of your farm business	4.07	3.86	5.27	0.022	1.92	0.058†

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Even though most of the results are significant, it is also relevant to highlight the fact that the mean values for non-adopters are high as well (most are above 3.00). This is important because most of the current non-adopters in the sample were interested in RE and up to 65% would consider investing in RE within the next five years.

The farmers' perceptions of self-efficacy are conditioned by the farmer's personal situation and the farm business characteristics. There was a strong positive but weak correlation between educational attainment and ability to identify market opportunities ($r = 0.182$, $p = 0.000$). As concerns the identification of opportunities, finding the right technology for the farm, estimating financial viability of RE, and financial management, there were significant positive differences between farmers with postgraduate level education and those with below secondary and secondary level educational qualifications. Further analysis revealed no differences amongst farmers on their ability to mobilise financial resources and lead planning processes at local council levels by level of education attained.

Similarly farmers with larger farm sizes (significant mean difference between 100 ha and above and those ranging from 20-50 ha = 0.15, $p = 0.04$) were more likely to report higher levels of confidence in their abilities to lead the planning permission process compared to non-adopters. In line with earlier results on the regulatory complexity involved in RE investment process, table 4.19 further shows that adopters (mean= 3.05) and non-adopters (mean= 2.78) were either unsure or not confident in their abilities to lead planning permission processes regarding RE enterprises. It is further justification why farmers depend so much on external consultants for assistance in putting together grant applications, planning permissions and even public consultations. These are often costs that are committed by the farmer without any guarantee of success. It also means that farmers with limited financial/physical resources may be excluded from participating in the RE sector. Bias towards larger scale farmers implies that smaller scale farmers are disadvantaged as regards access to external resources.

Regarding the degree of managerial complexity defined by the ownership status of the farm, it was expected that enterprises with higher levels of management complexity would be different from those below their rank ordering. Results showed that farmers operating as

limited companies reported significantly higher levels of confidence in their abilities to raise financial resources compared to sole proprietorships. The mean difference for farmers operating family partnerships was also significantly higher than the mean levels of confidence of sole proprietorships to identify business opportunities and find the right RE for the farm technology for the farm.

Another underlying issue related to perceptions of self-efficacy was the effect of agricultural business turnovers. Significant differences were observed for all the items of the self-efficacy by their levels of agricultural turnover. Overall, farmers with agricultural business turnovers of £500,000 and above reported significantly higher levels of confidence in their abilities to identify opportunities, identify appropriate farm enterprises, raise resources, lead planning permission processes and manage financial resources when compared to farmers with agricultural business turnovers less than £50,000. Respondents with yearly agricultural turnovers ranging from £100,000 - £499,999 also reported significantly higher levels of confidence to identify the right enterprises for the farm business, mobilize financial resources as well as organise and maintain financial records than farmers with yearly agricultural turnovers less than £50,000. There were no significant differences between farmers with turnovers of £100,000-£499,999 and those earning £500,000 on their levels of confidence to carry out entrepreneurial activities related to investment in RE enterprises.

4.5.2 Perceived desirability of RE ventures

Table 4.20 reveals that adopters and non-adopters agreed that there were new market opportunities in the RE sector to be exploited. As expected, adopters were more likely to be positive regarding the potential economic contribution of RE to farm business performance. Of the 55 RE investors identified in this study, half of them reported slight to

significant improvements in the farm performance which was attributable to RE enterprises on farms.

Table 4.20: 2 independent sample t-tests for adopters and non-adopters based on assessments of their perceived desirability of RE enterprise ventures

Perceived desirability of RE	Adopters (Mean)	Non-adopters (Mean)	Levenes test of equality	P	T-Value	2-tailed sig.
There are new market opportunities in RE if I want to exploit them	3.87	3.69	1.12	0.292	1.43	0.152
RE can help improve the economic success of my business	3.67	3.38	2.02	0.156	2.13	0.034*
If I start a RE enterprise it will help me achieve other important non-economic goals in my life	3.17	2.75	4.14	0.043	2.43	0.018*
RE is a viable business proposition compared to my existing agricultural businesses	3.30	2.84	0.89	0.347	2.94	0.004**

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Additionally, there was a significant difference between adoption categories regarding the potential contribution of RE to important non- economic goals. Adopters were more likely to agree. Farmers revealed that adoption of RE had been driven by the motive of being seen as environmentally friendly in the community. These farmers revealed this form of "branding" was helping them to attract visitors to their farms – other farmers, pupils and students, RE consultants etc. and thus improving their social acceptability and status.

Results from the pilot survey showed that some farmers invest in RE because of health and age reasons. In effect they were looking for enterprises for profit with limited labour

requirements and energy crops provided an ideal option. One farmer converted all the farm land (200 ha) to energy crops and since then does not regret the choice that was made as no physical labour is needed once the crop is established. Yet another farmer confirmed that by converting to heating the farm buildings with woodchips and pellets sourced from the farm woodland, energy bills and the use of oil for heating had dropped significantly. Heating of the farm premises was reported to be more regular throughout the year and the living standards of the farm household had improved due to consistent and the low cost heating option.

A key issue related to the adoption of RE enterprises is often the concern that they might not be viable compared to existing agricultural enterprises. Assuming that farmers are rational profit maximisers, farmers would only invest in these enterprises to the extent that they yield at least equal or higher profits compared to existing enterprise mix. Even though farmers are not always interested in profit maximization (Gasson *et al.* 1988, Jones 2006), it was still important to evaluate the perceptions of adopters and non-adopters concerning the viability of RE enterprises compared to existing agricultural businesses. The motivations for adoption have been reported and it can be seen that RE is unlikely to represent the main source of income on farms but can contribute significantly to overall business performance (cut costs, diversify income, provide environmental benefits etc.).

Table 4.20 also shows that there was a significant positive difference between adopters and non-adopters. Current adopters reported that RE enterprises were viable propositions compared to their existing enterprises. Non-adopters were more likely to have doubts about the viability of the enterprises. It is clear that adopters were able to respond in this way based on their experiences of managing RE enterprises. These are useful experiences which could be used to encourage other farmers to engage. Farmers often adopt a wait and see attitude when risky innovations such as RE are introduced in the market place

(Convery *et al.* 2012). Successful farmers can be used as champions in their communities to disseminate their experiences and hence encourage laggards to join in. This approach may improve uptake of RE enterprises on UK farms. This suggestion finds support from results of the pilot survey. All the 7 farmers interviewed during the pilot survey indicated that they had taken part in RE road shows/exhibitions and more importantly had visited other farmers to learn from their experiences. They suggest that these were the most important pieces of advice as they could relate with the experiences of their peers.

Further analysis showed that there was no significant difference between farmers on their perceptions of desirability by level of education and farm tenure type. Interestingly, significant differences existed on their perceptions by age, agricultural turnover, farm size and levels of managerial complexity defined by farm ownership. There was a significant positive difference between younger and older farmers on perceptions of opportunity. In effect, younger farmers between the age of 35-44 were more likely to view RE positively than those beyond 55 years old (35-44 and 55-64 mean diff, 0.13, $p = 0.012$; 35-44 years and 65 years and above mean diff, 0.14, $p = 0.003$). As expected, farm businesses above 100 ha with agricultural business turnovers of £500,000 and above were significantly different from those with lower farm sizes and farm incomes. Farmers operating limited companies and family partnerships were more favourable than those on sole proprietorships. There was no significant difference on the perceptions of opportunity between limited companies and family partnerships. The check for the potential influence of location on desirability perceptions, an analysis of variance showed that there was no significant difference between farmers' perceptions of desirability and the county of the respondent.

4.5.3 Summary – differences between adopters and non-adopters attitudes towards RE

The results of factor analysis revealed that there were two main attitudes with potential effect on farmers' adoption behaviours. These were the perceived self-efficacy and perceived desirability of RE enterprises. Perceived self-efficacy related to the farmer's level of confidence in his abilities to carry out RE projects while perceived desirability alluded to whether the farmer considered RE positively particularly with regards to the potential contribution of RE to economic and non-economic goals, the availability of markets for RE products and the opportunity cost of the enterprise compared to traditional or existing farm enterprises.

As expected adopters were more confident in their abilities to identify opportunities, identify the right type of technology, assess financial viability of the enterprises, mobilise resources, lead planning processes and manage and coordinate farm financial reports than non-adopters. In support of the results presented in part 3, perceived feasibility was conditioned by a number of other factors. Farmers with higher educational attainments, with larger farm sizes and agricultural incomes and those operating family partnerships and limited companies reported higher levels of self-efficacy than those reported by non-adopters.

It also came through the results that adopters were more likely to show higher perceived desirability of RE ventures than non-adopters. This is interesting because 52% of current adopters said farm business performance had improved slightly or significantly with financial contributions estimated at up to £25,000 to business turnover. It emerged non-adopters did not think RE would contribute to achieve non-economic goals. They also viewed RE as not being a viable business proposition compared to their existing farm

practices. This suggested the need to develop and diffuse information about successful exemplars which could help improve acceptability of the enterprises by farmers.

Like perceived self-efficacy, perceived desirability was influenced by age, farm business size and agricultural business incomes. There was no influence of location on perceived feasibility or desirability of RE enterprises. The results presented here suggest that farmers' cognitions play a very important role and distinguish those who invest and those who do not invest in RE enterprises. As suggested in the model in 2.8.4, the farmers' capacities and the farm business resources play an important role given that more resource capable ones are more likely to be adopters and that the resource base has some influence in their perceptions of feasibility and attractiveness of RE ventures.

The last part of this chapter (part IV) presents results of the multiple regression analysis to test the model and hypothesis developed in sections 2.8.4 and 2.8.5 chapter 2.

Chapter 4: Part IV

4.6 RE Investment Intentions of Current Non-adopters

The specific role of farmers and their actual or potential involvement with RE adoption and the wider community is potentially important but has not been addressed by research (Mattison and Norris, 2007, Sherrington and Moran, 2007, Sherrington *et al.* 2008, Tranter *et al.* 2011, Tate and Mbzibain, 2011). By carrying out an assessment of RE investment intentions, this study provides useful insights regarding the potential involvement of farmers. In this study, investment intentions refer to the intention of an individual to set up a new RE enterprise at some point in the future (Fitzsimmons and Douglas, 2010). Intentions represent the state of the mind that directs and guides actions of the entrepreneur towards the development and implementation of a business concept (Boyd and Vozikis, 1994). Azjen (1991) argues that intentions are the best single predictors of future behaviour. The focus of this section is to evaluate the factors which influence farmers' intentions to invest in these enterprises.

This section is an introduction to the fifth aim of the mail survey designed to understand farmers' future behaviour regarding the adoption of RE enterprises on farms. Questions 5.2a, b and c in the survey proforma were designed to collect data about non-adopters' intentions to invest in RE. The first question sought information about the respondent's level of interest in RE while the second hoped to find out whether the farmer had given any serious consideration to RE enterprises. Finally, the last question asked current non-adopters to state how likely it was that they will invest in RE in the next five years. Results of farmers' intentions to invest in RE enterprises are shown in figure 4.10.

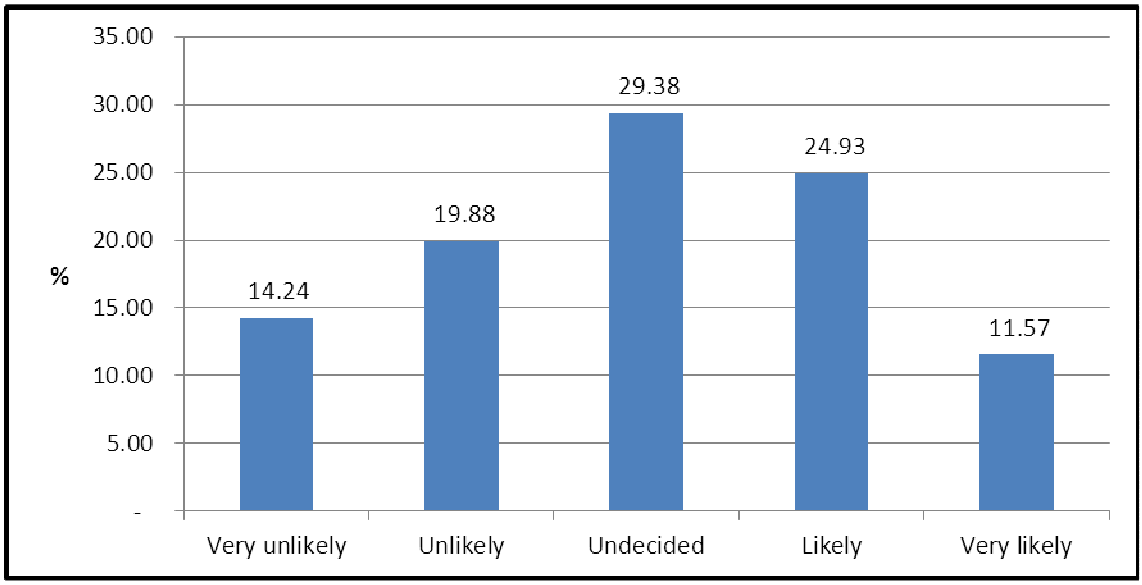


Figure 4.10: Farmers' intentions to invest in RE within the next five years

In line with Tranter *et al* (2010), very unlikely and unlikely are considered potential non-adopters while respondents answering unsure, likely and very likely are categorised as potential adopters. Based on this categorisation, figure 4.10 shows that 34% of current non-adopters were not likely to invest in a RE enterprise compared to 66% potential adopters.

Logically, the results in table 4.21 reveal that potential adopters are more likely to have larger farm sizes, to have higher agricultural turnovers, better educated, younger, operating mainly on partly owned or fully owned farms and running either family partnerships or limited companies. Non-adopters tend to be older, have smaller farm sizes, lower agricultural business turnovers, lower educational attainments, on tenanted farms and operating mainly as sole proprietors. It appears therefore that the policy makers need to adopt a differential policy approach to promoting RE rather than having a one size fit all approach. This is because less endowed farmers are likely to be discriminated against as larger farmers may use their resource bases to access policy support more than others.

Table 4.21: Differences between likely adopters and unlikely adopters based on farmer's traits and farm business characteristics

Farmer traits/business characteristic	Potential for investment	N	Mean Rank	U	P-2 tailed
Total farm area	1.00[13]	62	114.1	9755.5	0.000***
	2.00[14]	246	164.7		
Agricultural turnover	1.00	60	117.8	9152.0	0.000***
	2.00	249	164.0		
Education attainment	1.00	61	129.3	11392.0	0.002**
	2.00	245	159.5		
Age	1.00	62	179.0		
	2.00	249	150.3	10434.5	0.008**
Tenure	1.00	63	167.5	11884.5	0.091†
	2.00	246	151.8		
Ownership status				$\chi 2$= 16.97	0.001***

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

While there are clear differences between farmers based on farm based characteristics and traits, the differences are less obvious regarding their assessments of the favourability of the external support environment and perceptions of their abilities and the availability of opportunities for investment in RE.

[13]Non potential adopter
[14] Potential adopters

Table 4.22: 2 independent sample t-tests for likely and unlikely adopters by institutional outlook and attitudes towards RE

Variables	Potential adopters (Mean)	Non potential (Mean)	Levenes test of equality	P	T-Value	2-tailed sig.
Regulatory support for RE	3.21	3.10	0.02	0.882	-1.56	0.119
Regulatory complexity	2.42	2.32	0.20	0.656	-1.06	0.288
Cognitive institutions	2.73	2.65	0.26	0.612	-0.95	0.344
Society's admiration for entrepreneurship	3.42	3.49	2.51	0.114	0.53	0.594
Support of friends, family and associational networks	3.25	2.90	4.62	0.032	-3.02	0.003**
Perceived self-efficacy	3.56	2.95	12.10	0.001	-7.07	0.000***
Perceived desirability	3.35	2.81	0.00	0.978	-7.78	0.000***

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Table 4.22 showed three major differences between adopters and non-adopters. With regards to the external institutional environment, potential adopters were more likely to view the normative environment favourably compared to non-adopters. Potential adopters agreed more strongly that they had the support of family, friends and business networks. There was further support for the fact that potential adopters reported higher levels of perceived feasibility of RE ventures than potential non-adopters. Potential investors also reported higher perceived desirability of RE ventures.

4.6.1 Summary of differences between potential and non potential investors in RE

This section was devoted to evaluate intentions of current non-adopters. The descriptive analysis was important to identify potential significant factors affecting future behaviour which could be included in the multivariate data analysis in section 4.8. Current non-

adopters were asked three questions regarding their interest in RE enterprises, how much consideration they had given to this type of enterprise and finally whether they were going to try to set up RE on their farms. On the last question which was critical for the analysis, 66% of farmers said they were likely to set up RE on their farms. These farmers were referred to as potential adopters while the remaining 34% were referred to as non-adopters. This result suggests that farmers are attracted to these types of enterprises and a key policy challenge is therefore to move the farmers from having positive intentions to actual behaviour. A key research objective was then to evaluate the areas of difference between the potential and non-potential adopters. There were significant differences between potential and non-adopters adopters in many aspects:

Potential adopters were more likely to have larger farm sizes, higher agricultural business turnovers, better educated, younger, operating mainly on partly owned or fully owned farms and running either family partnerships or limited companies. Non-adopters tended to be older, had smaller farm sizes, lower agricultural incomes, lower educational attainments, on tenanted farms and operating mainly as sole proprietors. Potential adopters were more positive in their evaluation of the favourability of the institutional environment. All non-adopters evaluated the cognitive environment as well as local council support to be seriously lacking for RE development. It emerged that potential adopters thought they had support of family, friends and business networks (mean score 3.25) more than non-adopters (mean 2.90).

There was a significant difference between potential and non-potential adopters. Potential adopters appeared more confident (mean 3.56) in their abilities to identify market opportunities, mobilise necessary resources and set up RE enterprises more than non-adopters (mean 2.95). Similarly potential adopters were more likely to perceived that investing in RE was personally desirable (mean 3.35) well above the levels of desirability

observed amongst non-adopters and adopters (mean 2.81). This means that potential adopters thought there were opportunities for investment in RE, that RE could contribute towards economic and non-economic goals and that RE was a viable business proposition compared to existing agricultural enterprises. Section 4.7 presents results of regression analysis.

4.7 Factors influencing farmers' intentions to invest in RE ventures

This section provides an explanation of the effect of explanatory variables (farmers' traits, farm business characteristics, institutions and attitudes towards RE enterprises) on current non-adopters' investment intentions (dependent variable). In order to determine these effects, multiple linear regression analysis was employed. The key relationships tested in the model are presented in the conceptual framework (section 2.8.4). This section seeks to test hypotheses developed in Chapter 2, section 2.8.5 relating to factors affecting farmers' intentions to invest in RE enterprises. Firstly to investigate the main effects (average weight effects – Aiken *et al.* 1991) of structural, institutional and attitudinal variables on farmers' RE investment intentions. Secondly, evaluate the possibility of indirect effects of institutional and attitudinal variables on intentions (moderation and mediation effects).

4.7.1 The influence of the farm resource base on farmers' intentions

Hypothesis 1 suggested that the farm's resource base measured by the farmers' capacities and the farm business situation will influence farmers' intentions to invest in RE. Table 4.23 presents the regression analysis results for this proposed relationship. Table 4.23 shows that the farm resource base explained up to 17% of the variance in the dependent variable (intentions).

Table 4.23: The effect of farmer/farm resource situation on RE investment intentions

Variable	B	Std. Error	β	t	Sig.
(Constant)	4.19	0.323		12.98	0.000***
Dum_acco	0.38	0.180	0.12	2.11	0.036*
Dum_agricontract	0.55	0.171	0.18	3.22	0.001***
Dum_nonagricont	-0.01	0.241	0.00	-0.06	0.951
Dum_whoten	-0.59	0.197	-0.18	-3.01	0.003**
Dum_mainten	-0.26	0.209	-0.08	-1.24	0.216
Dum_mainown	-0.02	0.147	-0.01	-0.15	0.883
Dum_50	-0.81	0.207	-0.36	-3.90	0.000***
Dum_50_99	-0.36	0.218	-0.12	-1.67	0.096†
Dum_100_499	-0.17	0.176	-0.08	-0.96	0.337
Dum_belowsec	-1.03	0.360	-0.21	-2.85	0.005**
Dum_sec	-0.76	0.259	-0.34	-2.92	0.004**
Dum_uni	-0.43	0.278	-0.17	-1.55	0.123
Dum_5years	0.24	0.507	0.03	0.47	0.640
Dum_14years	0.07	0.309	0.01	0.24	0.813
Dum_24years	0.23	0.218	0.06	1.08	0.283
Dum_solpro	-0.16	0.252	-0.07	-0.64	0.524
Dum_part	-0.01	0.225	0.00	-0.04	0.968
R	**0.47**				
R^2	**0.22**				
Adj. R^2	**0.17**				
F Change	**4.40*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

The results show that in effect farmers are influenced by their traits and the farm business situation when deciding to add/or not an additional enterprise on the farm. The weak explanatory power suggests that there are other factors which affect intentions in addition to the traits and farm business characteristics.

A number of interesting results emerge from this analysis. First, it shows that the degree or level of diversification of the farmer affects investment intentions. Compared to farmers

involved in the production of food/packaging agricultural products on the farm, the results indicate that those offering accommodation services as well as letting out agricultural buildings are 12% more likely to invest in RE. It may be that RE could easily be used as a means of showing off the green credentials of the farm and hence attracting customers with environmental values.

It was also observed that farmers engaged in agricultural contracting (β= 0.18, t= 3.22, p= 0.001) were the most likely to invest in RE enterprises compared to those involved in food production/packaging on farm. This is to be expected as farmers involved in agricultural contracting are more likely to have the necessary equipment, experience, skills and networks needed to facilitate investment. This is the first time such results have been obtained in studies relating to the uptake of RE in the UK. It is surprising that until now the level of diversification on the farm has not been given any attention in RE adoption studies.

Table 4.23 further indicates that the type of farm tenancy has a strong influence on a farmer's investment behaviour. It was proposed that farmers on wholly owned farms were more likely to have a positive attitude towards investment in RE compared to those on mainly owned, partly tenanted and wholly tenanted farm enterprises. As expected, there was a significant difference between farmers on wholly tenanted farms and those with wholly owned farms. Farmers on wholly tenanted farms were 18 times less likely to show positive intentions towards investment in RE on their farms (β= - 0.18, t= - 3.01, p= 0.003). This means that the more the farmer has decision making control over the land resource the more likely they can add additional enterprises on the farm. Lack of ownership is therefore negatively related to RE energy adoption intentions.

It was hypothesised that farmers with agricultural business turnovers of above £500,000 would be more likely to invest in RE on their farms than those with lower incomes. Table

4.23 provides support for this hypothesis and there is a significant difference between farmers with less than £50,000 and those with turnovers above £500 000. The results indicate that farmers with turnovers of below £50,000 are 36% less likely to invest in RE on their farms. There is a marginal difference between farm businesses with turnovers between £50,000 -£99,999 and those with turnovers above £500,000. No significant differences were found between farm businesses with turnovers between £50,000 and £499,999 and those with turnovers above £500,000 even though as expected those with lower turnovers showed lower levels of intention.

As regards the influence of educational attainment on intentions, the model results are as expected. Farmers with below secondary levels of education were found to be 21% (β = - 0.21, t= - 2.85, p= 0. 0.005) less likely to invest in RE compared to those with postgraduate education. The same holds for those with secondary level of education even though surprisingly they were by far less likely (β = - 0.34, t= - 2.92, p= 0.004) to invest in RE compared to those with post university degree after controlling for all other variables.

Two dummy variables for farm type were created to investigate the influence of farm type on intentions. Cereal and dairy farms were chosen because earlier t-test analysis between adopters and non-adopters revealed significant differences by these farm types on intentions. An attempt was therefore made to investigate whether farm type would be an important predictor for investment intentions in RE. It was posited that there will be a positive relationship with cereal farm type and a negative relationship between dairy farm type and intention. Including these two dummies into Model one provided support for this proposition even though the results were not significant. Taking dairy for example, the results (β= - 0.03, t= - 0.480, p= 0.635) supported the idea that dairy farmers are less likely to invest in RE compared to those operating different other farm types. Farmers with other farm types were 3% more likely to show positive intentions towards adopting RE on their

farms compared to dairy farmers. Because these dummies did not prove significant in any other model, they are not included in further analysis.

The age variable was entered initially in the model but was insignificant. It was also insignificant in other subsequent models but the directions of the beta coefficients were in the expected direction. The results showed that farmers between 35 and 55 years were more likely to invest in RE on their farms than those from 55 years and above. Given the importance of this variable in innovation-adoption behaviour in agriculture, a decision was made to use the farmers' level of experience in agriculture as a proxy for age. Interestingly, the model significantly improved (R^2= 0.14 to R^2= 0.17) even though the results themselves were not significant. For this reason years of experience of the farmer is used in the remaining sections of this report as a proxy for the farmer's age.

Taking farm ownership type, no statistical difference was obtained between farmers operating sole proprietorships/family partnerships and those operating limited companies as regards intentions to invest in RE. However, the negative beta value for Dum_solpro shows that farmers running limited companies are likely to be more positive towards RE than those running sole managed farms. Based on these results, it can be said that H1 was sufficiently supported. It comes through that different dimensions of a farm's resource base may have positive or negative effects on intentions but overall, more resource capable farmers are more inclined to develop positive investment intentions that resource deprived ones.

4.7.2 The influence of the country's institutional profile on RE investment intentions

A number of hypotheses were developed to capture the direct effect of the variables on intentions as well as to investigate the potential existence of co-dependencies between the regulatory dimensions and normative dimensions. The first hypothesis was:

H2: The country's institutional profile will influence farmers' intentions to invest in RE enterprises

Based on the results of the factor analysis obtained in chapter 3, the country institutional profile items loaded on five factors. The internal reliabilities of the constructs were adequate as shown in section 3.5 chapter 3.

Table 4.24: Summary of measures of the country's institutional profile used in the study

Hypothesis	Measures	No of Items	Cronbach α
	Regulatory institutional profile		
H2a	Regulatory support for RE	6	0.77
H2b	Regulatory complexity	3	0.76
	Cognitive institutional profile		
H2c	Cognitive institutions	4	0.68
	Normative institutional profile		
H2d	Social acceptability of entrepreneurship	2	0.80
H2e	Support of family, friends and associational networks	3	0.83

Given the number of constructs presented in table 4.24, the following hypotheses are appropriate as represented in figure 4.11.

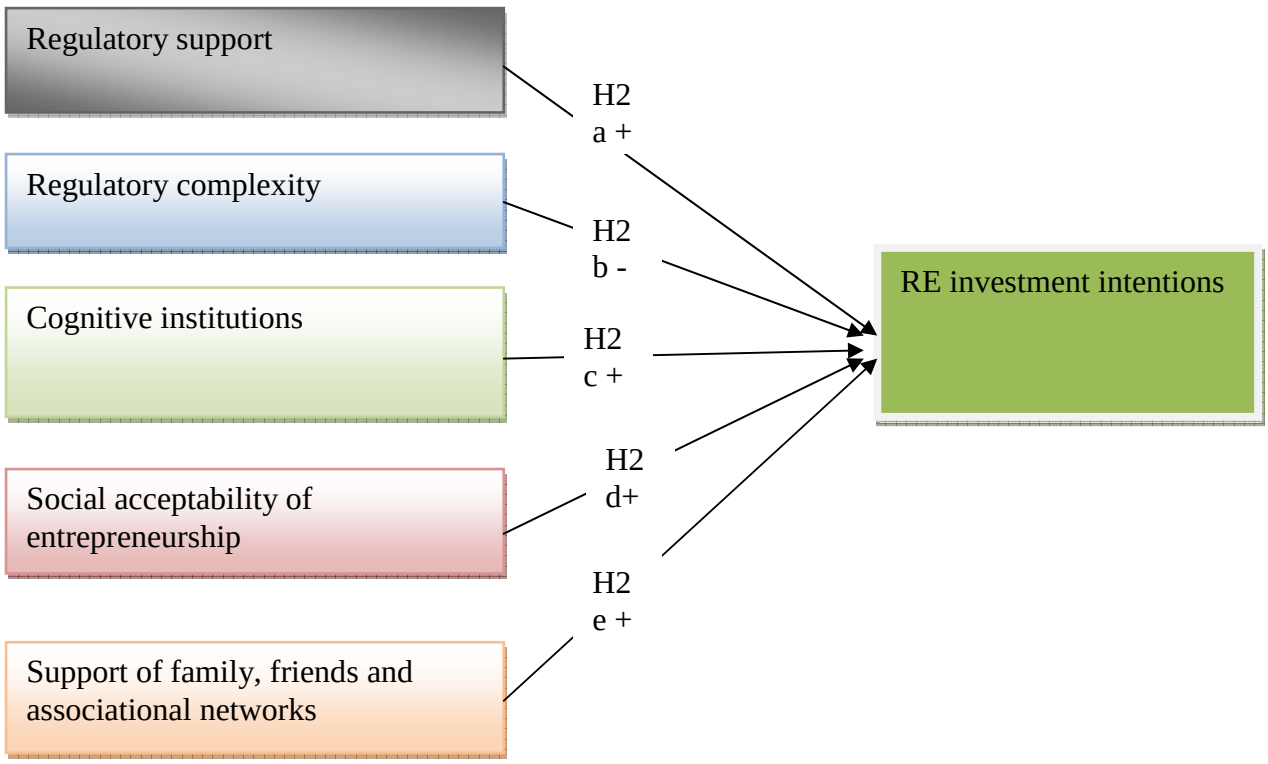


Figure 4.11: Research hypotheses for the effect of institutions on farmers' intentions to invest in RE enterprises

Results of this analysis are presented in table 4.25.

Table 4.25: Direct effect of the country's institutional dimensions on farmers' intentions

Variable	B	SEE	β	t	Sig.
(Constant)	3.37	0.504		6.69	0.000***
Dum_acco	0.38	0.178	0.12	2.14	0.034*
Dum_agricontract	0.51	0.171	0.17	2.99	0.003**
Dum_nonagricont	0.04	0.240	0.01	0.18	0.858
Dum_whoten	-0.52	0.195	-0.16	-2.68	0.008**
Dum_mainten	-0.31	0.206	-0.09	-1.50	0.134
Dum_mainown	-0.05	0.144	-0.02	-0.36	0.718
Dum_50	-0.71	0.207	-0.31	-3.43	0.001***
Dum_50_99	-0.34	0.215	-0.11	-1.56	0.121
Dum_100_499	-0.18	0.175	-0.08	-1.05	0.296
Dum_belowsec	-1.07	0.356	-0.22	-2.99	0.003**
Dum_sec	-0.83	0.256	-0.37	-3.24	0.001***
Dum_uni	-0.53	0.274	-0.21	-1.94	0.054†
Dum_5years	0.43	0.504	0.05	0.85	0.396
Dum_14years	0.02	0.306	0.00	0.05	0.958
Dum_24years	0.26	0.214	0.07	1.19	0.235
Dum_solpro	-0.06	0.252	-0.03	-0.25	0.805
Dum_part	0.01	0.222	0.01	0.06	0.952
Regulatory support	0.10	0.100	0.06	1.03	0.302
Regulatory complexity	0.00	0.071	0.00	0.04	0.966
Cognitive institutional support	0.20	0.092	0.13	2.14	0.033*
Society's admiration for entrepreneurship	-0.13	0.060	-0.12	-2.09	0.037*
Support of friends, family and associational networks	0.12	0.062	0.12	2.00	0.046*
R	**0.52**				
R^2	**0.27**				
Adj. R^2	**0.20**				
R^2 change	**0.05**				
F change	**3.16*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

4.7.2.1 Influence of the regulatory institutional dimension on farmers' intentions

Findings presented in table 4.25 indicate that regulatory support and regulatory complexity variables are not directly related to investment intentions providing no support for H2a, H2b. Though the results are not significant, they are in the expected positive direction. For example, an increase in one standard deviation in perceived regulatory support for RE would result in a corresponding 6% increase in investment intentions (β= 0.06, t= 0.04, p= 0.966). To understand the results further, one way analysis of variance was carried to tease out the underlying reasons for the results.

Table 4.26: One way ANOVA for the association between regulatory support for RE on intentions

Variable	F	Sig.
Government organisations assist farmers start RE	0.683	0.768
Government sponsors organisations that help farmers invest in RE	1.155	0.315
Current policies encourage farmers to adopt RE	3.151	0.000***
Local councils provide support to farmers to set up RE on farms	0.639	0.808
Government grants are available for farmers starting RE enterprises	1.882	0.036*
Banks have funds available for farmers starting RE enterprises	1.043	0.409

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Table 4.26 indicates that two underlying factors had significant association with farmers' intentions to invest in RE. For procedural requirements, no underlying items were associated with intentions. This is unexpected because red tape and planning problems were identified as some of the most important barriers for investment. It may be that even though they are important, they may do so only indirectly through attitudes about RE.

4.7.2.2 The influence of the cognitive institutional dimension on intentions

Results in table 4.25 provide support for the relationship between cognitive factors and intentions (hypothesis 2c). Table 4.25 shows that farmers who assess the cognitive environment favourably are 13 times (β= 0.13, t= 2.14, p= 0.033) more likely to develop positive intentions than those viewing it as unfavourable. A 1% change in the standard deviation of the independent variable would lead to a 13% increase in intentions.

These results while very interesting mask the reality as to how farmers assess the cognitive environment more generally. Unfortunately, less than 40% of all respondents judged the cognitive environment favourably suggesting that more needs to be done to improve the environment and thus reduce barriers to the social acceptability of the enterprises as well as their adoption. This has policy implications as it shows that many farmers are in doubt regarding RE information, funding and skills development opportunities/programmes.

4.7.2.3 The influence of the normative institutional dimension on farmers' intentions

Questions asked in the questionnaire under section 2 were related to social admiration/acceptability of entrepreneurship. It was hypothesized (figure 4.11) that there will be a positive association between this social acceptability of entrepreneurship and farmers' intentions to invest in RE (H2d). Results from table 4.25 provide support for the hypothesis even though the sign of the β is negative (β= -0.12, t= -2.09, p= 0.034). The implication of this finding is that a one standard deviation change in public admiration for entrepreneurship in the RE sector, would rather lead to a 12% change in intentions. Because the β coefficient is negative, it is likely that there may be more normative disapproval of individuals starting RE enterprises than has been previously thought. This adds up to the fact that even though there is overall positive public acceptance of RE

production many people are less likely to accept individuals setting up enterprises in their backyards. Clearly, there is differential opposition to RE as some enterprises are viewed more negatively (onshore wind, energy crops) than others (e.g. offshore wind, solar, and hydro) and the relationship between social acceptance of entrepreneurship in the RE sector might not be linear.

Model 2 (table 4.25) also assessed the relationship between the second dimension of the normative institutional profile – perceived support of family, friends and business networks and entrepreneurial intentions. The model shows that support of social relationships is positively associated to intentions (β= 0.12, t= 2.00, p= 0.046) thus providing support to hypothesis H2e. Further analysis indicates that all the items measuring the support of family, friends and business networks were significantly associated with intentionality (table 4.27).

Table 4.27: One way ANOVA for the association between the support of family, friends and associational networks on intentions

Variable	F	Sig.
My family has social relationships that can help my business	1.950	0.028*
I have friends and family that can assist my business development	1.912	0.032*
I have business networks that I can count on for help in case of difficulties	2.730	0.002**

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Looking at the model summary in table 4.25, the country's institutional profile contributes to improve the explanatory power of the model and the changes brought about by the introduction of the institutional variables is highly significant. This is justification that

taken alone external factors have little explanatory power on intentions. It may be that co-dependences are better able to influence farmers' investment behaviours (H3).

4.7.2.4 The moderating effect of social norms on the effect of regulatory factors on entrepreneurial intentions

Meek *et al* (2010) show in their study of environmental entrepreneurship in the United States that social norms play a supplemental role to government policy in promoting the uptake of solar energy enterprises. Spenser and Gomez (2004, p.1106) proposed that:

> 'future research should clarify the possible effects of different combinations of normative, cognitive and regulatory institutions on a diverse set of entrepreneurial activity and explore the possibility that interaction effects between the normative dimension and other dimensions will help predict levels of entrepreneurship'.

Based on this proposition, it was hypothesized that:

H3: There are co-dependencies between the different dimensions of the country's institutional profile and in their influence on farmers' intentions to invest in RE enterprises

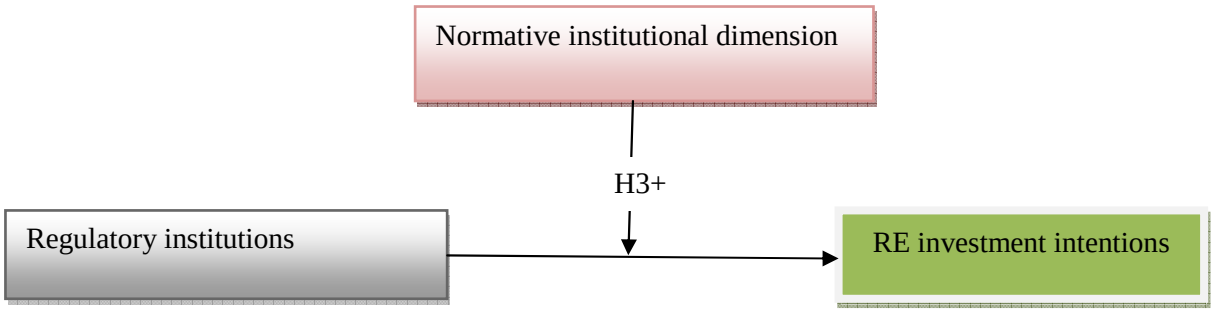


Figure 4.12: Proposed moderation effect of normative institutions on the effect of regulatory institutions on farmers' investment intentions

Results of this analysis can be found in table 4.28 below.

Table 4.28: The moderating effect of normative institutions on entrepreneurship intentions

Variables	B	SEE	β	t	Sig.
(Constant)	3.24	0.498	3.24	6.50	0.000***
Dummies accommodation	0.33	0.176	0.10	1.84	0.067
Dummies agricultural contracting	0.47	0.169	0.16	2.76	0.006**
Dummies non-agricultural contracting	0.12	0.238	0.03	0.50	0.617
Dum_whoten	-0.58	0.193	-0.18	-3.02	0.003**
Dum_mainten	-0.32	0.203	-0.10	-1.57	0.117
Dum_50	-0.75	0.205	-0.33	-3.68	0.000***
Dum_50_99	-0.33	0.212	-0.11	-1.54	0.126
Dum_belowsec	-1.16	0.352	-0.24	-3.28	0.001***
Dum_sec	-0.88	0.253	-0.40	-3.46	0.001***
Dum_uni	-0.54	0.270	-0.22	-2.00	0.046*
Dum_5years	0.49	0.497	0.05	0.98	0.329
Dum_14years	0.07	0.302	0.01	0.23	0.821
Dum_24years	0.23	0.211	0.06	1.09	0.279
Regulatory support for RE	0.11	0.098	0.07	1.13	0.261
Regulatory complexity	-0.01	0.070	0.00	-0.07	0.942
Cognitive institutions	0.20	0.090	0.14	2.26	0.025*
Society's admiration for entrepreneurship	-0.08	0.061	-0.08	-1.38	0.169
Support of friends, family and associational networks	0.14	0.062	0.13	2.20	0.029*
Regulatory support X social acceptability of entrepreneurship	0.17	0.058	0.17	2.96	0.003*
Regulatory support X normative support of family, friends and associational networks	-0.04	0.005	-0.02	-1.04	0.234
R	**0.54**				
R^2	**0.29**				
Adj. R^2	**0.23**				
F change	**8.75****				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Results in table 4.28 show that society's acceptability of entrepreneurship indeed plays a significant supplemental role in influencing the effect of government policy on intentions (β= 0.17, t= 2.96, p= 0.003). This is interesting because there was no direct significant effect of the regulatory factors on intentions in table 4.25 but taken together, a significant result was obtained. Results in this model emphasise the important role informal institutions may play in the uptake of RE enterprises.

To better understand the moderation effects of the social norm on intentions, guidance was obtained from Dawson (2011, http://www.jeremydawson.co.uk/slopes.htm, accessed 22.10.2011) to present the results in the form of a graph. See fig 4.13.

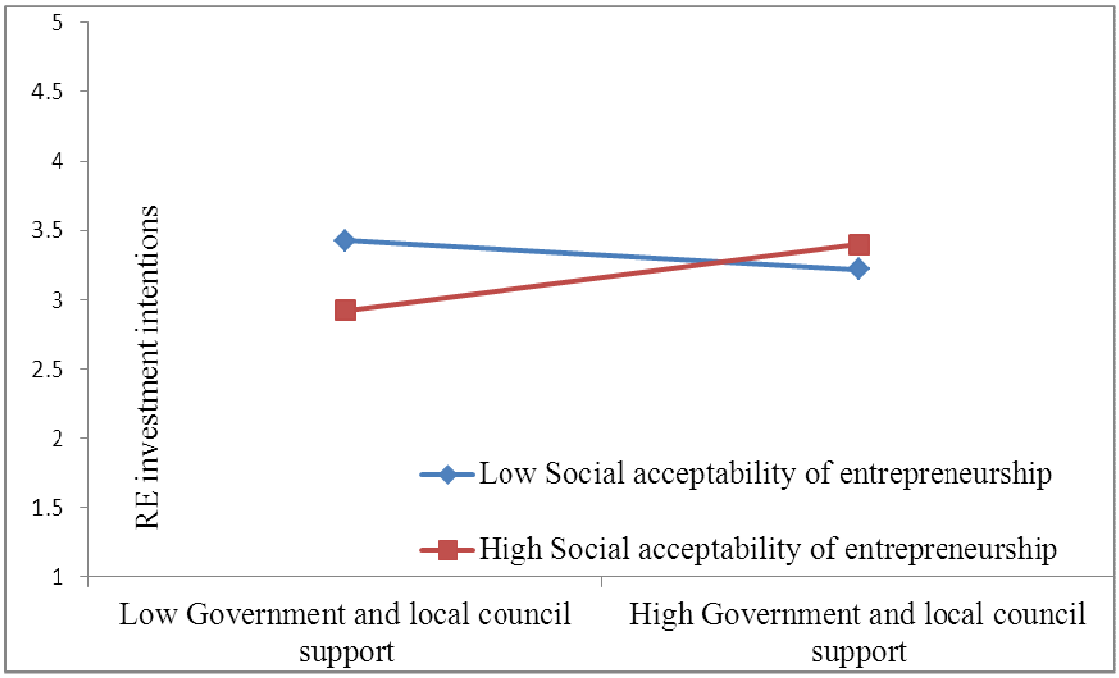


Figure 4.13: Interaction effect between government and local council support and society's acceptability of entrepreneurship.

The existence of an interaction signifies that the regression of intentions on government and local council support depends on levels of social acceptability of entrepreneurship. It emerges that intentions decrease with decreasing social acceptability of entrepreneurship even with high levels of government support for entrepreneurship. The figure also points to

the fact that intentions are likely to be higher at higher levels of government support and higher levels of social acceptability of entrepreneurship.

4.7.2.5 Summary

The role of external institutional factors on intentions

Firstly, the results show that regulatory institutional dimension was not directly related to investment intentions.

Secondly, results emerging from the analysis showed that there was a positive relationship between the supportiveness of the cognitive environment and investment intentions. This suggested that farmers viewing the environment as favourable were 13% more likely to develop positive intentions.

Third, mixed results were obtained for the influence of the normative institutional dimension on farmers' intentions. On the first aspect of the normative institutional environment relating to society's acceptability of entrepreneurship, the results obtained were contrary to expectation even though the hypothesis was supported. It emerged that there was a negative influence of society's acceptability of entrepreneurship on farmers' intentions to invest in RE enterprises suggesting that intentions would rather decrease with increasing admiration for entrepreneurship. Results from the pilot survey also revealed that even though many people were supportive of RE very few would accept RE enterprises in their backyards because of visibility and landscape value concerns. The findings also suggest that social acceptability of RE may not have a linear relation (Wüstenhagen *et al.* 2007) with adoption as earlier results from the pilot showed that negativity towards RE entrepreneurship was most likely during planning and declined during implementation of the RE projects. On the second aspect relating to the normative institutional profile, it

emerged that perceived support of family, friends and business networks had a positive influence on farmers' entrepreneurial intentions.

Overall, it can be said that what really matters for positive RE investment intentions to develop, is a favourable cognitive and normative environment (Kostova and Roth, 2002). It shows that informal institutions may play a far more important role in promoting the development of RE than has been previously thought. Informal rather than formal institutions may therefore be primordial for future development of a farm driven RE sector. Formal institutions may influence intentions only indirectly. In effect, results confirmed this hypothesis as it emerged that the regulatory institutional profile would only be efficacious at different levels of normative institutional support (see figure 4.13).

The existence of a positive interaction effect showed that social acceptability of entrepreneurship played an important supplementary role on the effect of formal policies on farmers' investment intentions and this is an important theoretical contribution of this study. From the interaction graph (figure 4.13) it emerged that intentions would decrease with decreasing social acceptability of entrepreneurship even with high levels of government support for entrepreneurship.

After the introduction of the institutional variables and the moderation effects into the baseline model, the explanatory power of the baseline model improved by 6%. Factors characterizing the farm resource base and the country institutional profile explained 23% of the variance in farmers' investment intentions. The low level of prediction was an indication that other factors needed to be considered.

4.8 The influence of farmers' attitudes towards RE enterprises on entrepreneurial intentions

Stern (2008) argued that energy models which only consider technical and economic concerns make serious prediction mistakes. Modeling benefits in many ways when problem based behavioural aspects are integrated (Stern 2008, Huijts *et al.* 2012, Masini and Menichetti, 2012). This is because mechanistic models fail to consider sociological and strategic aspects of decision making and therefore models become irrelevant because of trend shifts (Roos and Rakos, 2000). Roos and Rakos (2000) further the argument that most of such models are based on a number of strict statistical assumptions and depend on data which is collected ex-post meanwhile farmers decisions take place ex-ante. Integrating behavioural aspects and modeling based on ex-ante data should further aid understanding of future investment behaviour amongst farmers.

This section seeks to provide understanding of the influence of farmers' attitudes towards RE enterprises and investment intentions. The investigation focused on two central attitudes related to perceived feasibility/self-efficacy and desirability of RE ventures as developed in 2.8.4 (Krueger, 1993, Krueger *et al.* 2000, Bandura, 1977, Bandura, 1989).

The hypothesis tested is:

H4: Farmers' perceived self-efficacy and desirability of RE enterprises will influence their intentions to invest in RE enterprises

The expected directions of effect are presented in figure 4.14

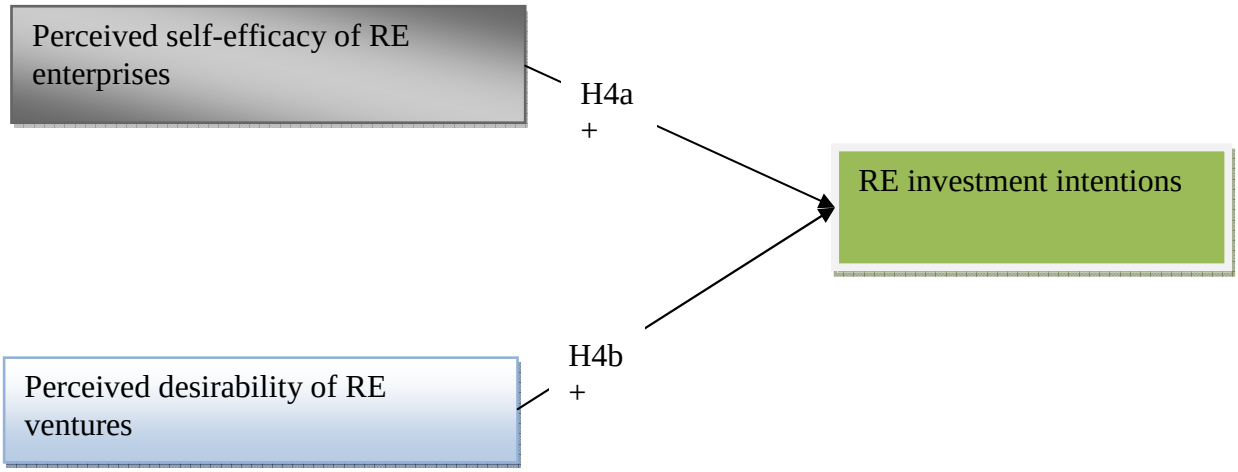


Figure 4.14: Expected direction of the relationships between farmers' attitudes towards RE ventures

4.8.1 The influence of perceived self-efficacy of RE ventures on intentions

It was hypothesised that perceived self-efficacy will be positively and directly related to RE investment intentions. Results from table 4.29 provide support for H4a. The results show that for a one standard deviation increase in perceived self-efficacy, there will be a 28% increase in investment intentions (β= 0.0.28, t= 9.76, p= 0.000).

Table 4.29: The effect of perceived self-efficacy and desirability of RE ventures on farmers' intentions to invest in RE enterprises

Variables	B	SEE	Beta	t	Sig.
(Constant)	0.08	0.425		0.20	0.843
Dummies accommodation	0.28	0.144	0.09	1.96	0.051
Dummies agricultural contracting	0.50	0.136	0.16	3.64	0.000***
Dummies non-agricultural contracting	0.03	0.193	0.01	0.13	0.895
Dum_solpro	-0.05	0.201	-0.02	-0.24	0.811
Dum_part	-0.05	0.180	-0.02	-0.29	0.770
Dum_whoten	-0.50	0.157	-0.15	-3.20	0.002**
Dum_mainten	-0.07	0.167	-0.02	-0.43	0.670
Dum_mainown	0.06	0.117	0.03	0.55	0.579
Dum_50	-0.25	0.171	-0.11	-1.45	0.149
Dum_50_99	0.00	0.175	0.00	0.00	1.000
Dum_100_499	0.07	0.142	0.03	0.51	0.611
Dum_5years	0.00	0.406	0.00	0.00	0.996
Dum_14years	-0.07	0.248	-0.01	-0.26	0.791
Dum_24years	0.22	0.177	0.06	1.26	0.210
Dum_belowsec	-0.64	0.296	-0.13	-2.16	0.031*
Dum_sec	-0.43	0.216	-0.19	-2.00	0.047*
Dum_uni	-0.14	0.229	-0.06	-0.62	0.535
Perceived self-efficacy	0.38	0.066	0.28	5.70	0.000***
Perceived desirability	0.69	0.073	0.44	9.47	0.000***
R	**0.72**				
R^2	**0.51**				
Adj. R^2	**0.48**				
F change	**78.82*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

A further analysis of variance shows that all the six items of the perceived self-efficacy scale are strongly associated to intentions – see table 4.30.

Table 4.30: One way ANOVA - the effect of individual items on farmers' intentions

Items	**F**	**Sig.**
Identify new market opportunities and act on them	6.208	0.000***
Find right technology for the farm	5.693	0.000***
Estimate economic viability of RE	6.787	0.000***
Raise financial resources	6.270	0.000***
Lead planning permission at local council level	3.085	0.000***
Organise and maintain financial records	3.032	0.000***

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

4.8.2 The influence of perceived desirability of RE enterprises on investment intentions

It was hypothesized that perceived desirability will be directly related to RE investment intentions. Results from table 4.29 also provide support for H4b. The results show that for a one standard deviation increase in the perceptions of desirability, there will be a 44% increase in investment intentions (β= 0.44, t= 9.46, p= 0.000). A one way analysis of variance (table 4.31) showed that all the four items making up the perceived desirability scale were significantly associated to intentions.

Table 4.31: One way ANOVA - the effect of individual scale items on farmers' intentions

Item	F	Sig.
RE will contribute to achieve non-economic goals	2.818	0.001**
There are new market opportunities in RE	9.965	0.000***
RE is a viable option compared to existing farm enterprises	8.228	0.000***
RE can improve economic performance of the farm	2.853	0.001***

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Results obtained from table 4.29 show that attitudes have a very significant effect on the venture decision making creation process. Perceived desirability of RE enterprises emerged as a more important factor affecting intentions than the farmers' perceived feasibility of the RE venture. What this suggests is that farmers are more likely to develop positive intentions towards RE if they realise that the enterprises have potential economic and non-economic contributions to the farmers' goals. Investment in RE is certainly entrepreneurial as it is observed that farmers would pursue opportunities for investment despite lower levels of confidence in their abilities to lead the investment processes themselves. It was reported earlier that the most important investment barrier relates to high investment costs and planning problems. Despite these difficulties, analysis of the sources of capital for investment used by current adopters showed that very few had access to credits or government subsidies with the highest category using personal and business savings. This shows that farmers were not limited by their own resources but were in pursuit of the economic and non-economic opportunities offered by RE. This has important implications for policy.

It is unlikely that farmers consider their abilities and assess opportunities at different periods during the decision making process. The two factors are entered simultaneously in the model to assess the possible effects on the predictive power of the model.

4.8.3 Joint effect of desirability and self-efficacy of a venture on intentions

Shapero and Sokol (1982) argued that perceptions of feasibility and desirability of a new venture are created sequentially rather than simultaneously as posited by Fitzsimmons and Douglas (2010) and Krueger (1993). Research findings on this issue continue to be mixed however. This research seeks to contribute to the understanding of interaction effects of these variables on entrepreneurial intentions. These results are presented in table 4.32.

Table 4.32: Effect of perceived self-efficacy and desirability on intentions

Variables	B	SEE	β	t	Sig.
(Constant)	3.63	0.291		12.48	0.000***
Dummies accommodation	0.28	0.145	0.09	1.96	0.052†
Dummies agricultural contracting	0.50	0.137	0.17	3.65	0.000***
Dummies non agricultural contracting	0.03	0.193	0.01	0.14	0.891
Dum_solpro	-0.06	0.204	-0.02	-0.30	0.767
Dum_part	-0.05	0.180	-0.02	-0.30	0.768
Dum_whoten	-0.52	0.158	-0.16	-3.26	0.001***
Dum_mainten	-0.07	0.169	-0.02	-0.42	0.673
Dum_50	-0.26	0.172	-0.11	-1.50	0.135
Dum_50_99	0.00	0.176	0.00	-0.01	0.994
Dum_100_499	0.08	0.143	0.04	0.55	0.581
Dum_5years	-0.01	0.408	0.00	-0.03	0.979
Dum_14years	-0.06	0.248	-0.01	-0.25	0.806
Dum_24years	0.22	0.178	0.06	1.25	0.211
Dum_belowsec	-0.63	0.298	-0.13	-2.11	0.036*
Dum_sec	-0.42	0.218	-0.19	-1.92	0.056†
Dum_uni	-0.14	0.230	-0.05	-0.60	0.552
Perceptions of self-efficacy	0.30	0.054	0.28	5.54	0.000***
Perceptions of desirability	0.47	0.051	0.44	9.28	0.000***
Perceived self-efficacy x perceived desirability	-0.01	0.013	-0.02	-0.40	0.691
R	**0.71**				
R^2	**0.51**				
Adj. R^2	**0.47**				
F change	**0.58**				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

By including the interaction effect in the model, the amount of variance explained decreased from 48% to 47% as shown in table 4.32. The model summary in table 4.32 shows that F change was not significant. The β coefficient for the interaction effect term was found to be negative but statistically non-significant suggesting that different possible combinations may be required to form intentions – in effect that these variables do not

have to be positive for intentions to form. Given that the effects were statistically non-significant, it may be that farmers consider feasibility and desirability at different moments as posited by Shapero and Sokol (1982) even though different levels of the two together are needed for intentions to form as suggested by Fitzsimmons and Douglas (2010).

4.9 Mediation effects of attitudinal variables

It was hypothesised in section 2.8.5 that:

H6: The influence of the farm business resource base on farmers' intentions will be mediated by perceived self-efficacy and desirability of RE enterprises

H7: The influence of the country's institutional profile on farmers' intentions will be mediated by farmers' perceived self-efficacy and desirability of RE enterprises

The mediation effects were analysed in this thesis by following the widely used method proposed by Kenny and Baron (1986). According to these authors, for a mediation effect to exist, a number of conditions have to be met: (i) the independent variable should be directly related to the dependent variable, (ii) the mediating variable must affect the dependent variable, (iii) the independent variable must affect the mediator and when the independent and mediator variables are regressed against the dependent variable, the resulting effect of the independent variable on the dependent variable most be lower than the result obtained in first step. This procedure established by Baron and Kenny (1986) was used to establish the conditions of mediation outlined. Results of the first step are shown in table 4.33 below.

4.9.1 Step 1: Direct effect of independent variables on the dependent variable (intentions)

Table 4.33: Establishing mediation step 1

Variable	B	SEE	β	t	Sig.
(Constant)	3.37	0.504		6.69	0.000***
Dum_acco	0.38	0.178	0.12	2.14	0.034*
Dum_agricontract	0.51	0.171	0.17	2.99	0.003**
Dum_nonagricont	0.04	0.240	0.01	0.18	0.858
Dum_whoten	-0.52	0.195	-0.16	-2.68	0.008**
Dum_mainten	-0.31	0.206	-0.09	-1.50	0.134
Dum_50	-0.71	0.207	-0.31	-3.43	0.001***
Dum_50_99	-0.34	0.215	-0.11	-1.56	0.121
Dum_100_499	-0.18	0.175	-0.08	-1.05	0.296
Dum_belowsec	-1.07	0.356	-0.22	-2.99	0.003**
Dum_sec	-0.83	0.256	-0.37	-3.24	0.001***
Dum_uni	-0.53	0.274	-0.21	-1.94	0.054†
Dum_5years	0.43	0.504	0.05	0.85	0.396
Dum_14years	0.02	0.306	0.00	0.05	0.958
Dum_solpro	-0.06	0.252	-0.03	-0.25	0.805
Dum_part	0.01	0.222	0.01	0.06	0.952
Regulatory support for RE	0.10	0.100	0.06	1.03	0.302
Regulatory complexity	0.00	0.071	0.00	0.04	0.966
Cognitive institutional support	0.20	0.092	0.13	2.14	0.033*
Society's admiration for entrepreneurship	-0.13	0.060	-0.12	-2.09	0.037*
Support of friends, family and associational networks	0.12	0.062	0.13	2.00	0.046*
R	**0.52**				
R^2	**0.27**				
Adjusted R^2	**0.20**				
F change	**3.16*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

The results show a number of significant results:

1. There is a significant positive influence of the farm resource base on intentions to invest in RE enterprises. Specifically, the level of diversification, level of education of the farmer, agricultural incomes, and the type of land occupancy agreement (e.g. farmers with wholly owned farms the most likely to have positive intentions).
2. The cognitive and normative dimensions of the country's institutional profile have a statistically significant influence on farmers' investment intentions.

Details of these relationships were presented in sections 4.7.1 and 4.7.2.

The second step towards establishing mediation according to Kenny and Baron (1986) is that the proposed mediating variables must be directly related to the dependent variable.

4.9.2 Step 2: The direct effect of the mediating variables

The second step in the Baron and Kenny (1986) procedure to establish mediation involves regressing the expected mediation variables against the dependent variable. The relation must be significant for there to exist any possibility of mediation.

As expected there was a positive relationship between perceived self-efficacy and desirability of RE ventures and intentions. Details of these relationships have been provided in section 4.8. The second condition proposed by Baron and Kenny (1986) was therefore established. Results are shown in table 4.34.

Table 4.34: The mediating effect of perceived self-efficacy and desirability

Variables	B	SEE	Beta	t	Sig.
(Constant)	0.08	0.425		0.20	0.843
Dummies accommodation	0.28	0.144	0.09	1.96	0.051
Dummies agricultural contracting	0.50	0.136	0.16	3.64	0.000***
Dummies non agricultural contracting	0.03	0.193	0.01	0.13	0.895
Dum_solpro	-0.05	0.201	-0.02	-0.24	0.811
Dum_part	-0.05	0.180	-0.02	-0.29	0.770
Dum_whoten	-0.50	0.157	-0.15	-3.20	0.002**
Dum_mainten	-0.07	0.167	-0.02	-0.43	0.670
Dum_mainown	0.06	0.117	0.03	0.55	0.579
Dum_50	-0.25	0.171	-0.11	-1.45	0.149
Dum_50_99	0.00	0.175	0.00	0.00	1.000
Dum_100_499	0.07	0.142	0.03	0.51	0.611
Dum_5years	0.00	0.406	0.00	0.00	0.996
Dum_14years	-0.07	0.248	-0.01	-0.26	0.791
Dum_24years	0.22	0.177	0.06	1.26	0.210
Dum_belowsec	-0.64	0.296	-0.13	-2.16	0.031*
Dum_sec	-0.43	0.216	-0.19	-2.00	0.047*
Dum_uni	-0.14	0.229	-0.06	-0.62	0.535
Perceived self-efficacy	0.38	0.066	0.28	5.70	0.000***
Perceived desirability	0.69	0.073	0.44	9.47	0.000***
R	**0.72**				
R^2	**0.51**				
Adjusted R^2	**0.48**				
F change	**78.82*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

These results were presented in sections 4.8.1 to 4.8.3.

4.9.3 Step 3: The relationship between the independent variable and the mediating variable - Path analysis 2

The third step in the Baron and Kenny (1986) procedure requires that there exist a relationship between the institutional variables and mediating variables. To establish the existence of these relationships, path analysis techniques were used.

Path analysis is an extension of multiple regression procedures. It entails the use of multiple regression to explicitly formulated causal models. It cannot establish causality but it helps to provide quantitative estimates of the causal connections between sets of variables (Bryman and Cramer, 2009). It is useful way for identifying a parsimonious model where one has at least an implicit causal ordering (Krueger, 1993). This analysis entailed regressing variables (farm resource base and country institutional profile) on attitudes, re-specifying the models by redoing the regression and pruning all non-significant paths.

4.9.3.1 The influence of independent variables on perceived self-efficacy of RE enterprises

To investigate the factors affecting perceived feasibility, the farm resource variables as well as the institutional variables were regressed on the dependent variable (perceived feasibility of RE enterprises). The model explained 25% of the variance in the dependent variable. After controlling for the non-significant variables and re-running the model, the explanatory power remained the same.

Table 4.35a shows, a number of structural variables had significant relationships with the proposed mediating factor (perceived feasibility of RE ventures). The farmer's level of education and farm business turnover were significantly and positive influencers of perceived feasibility of investing in RE ventures.

Table 4.35a: Re-specified model of effects on perceived self-efficacy of RE venture

Independent variable	B	SEE	β	Sig.
(Constant)	3.04	0.247		0.000***
Dummies accommodation	0.27	0.103	0.12	0.009**
Dum_50	-0.18	0.082	-0.10	0.032*
Dum_belowsec	-0.84	0.241	-0.21	0.001***
Dum_sec	-0.84	0.166	-0.52	0.000***
Dum_uni	-0.59	0.175	-0.33	0.001***
Regulatory support for RE	0.19	0.022	0.17	0.001***
Cognitive institutional support	0.25	0.054	0.23	0.000***
Society's admiration for entrepreneurship	-0.07	0.037	-0.09	0.050†
Support of friends, family and associational networks	0.21	0.037	0.28	0.000***
Adjusted R^2	**0.25**			
F change	**15.71*** **			

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

The results show that farmers operating a diversified business (agricultural leasing and accommodation) were 12% more likely to reveal higher levels of self-efficacy compared to those operating food packaging businesses as diversified enterprises. Farm businesses with agricultural turnovers of above £500,000 were 10% more likely to report higher levels of confidence in their abilities to set up and run viable RE enterprises compared to those with turnovers below £50,000. The level of educational attainment of the farmer appeared to be the most significant influence on levels of self-efficacy (β= 0.52, p= 000). This means for example that a farmer with a postgraduate degree was 52 times more likely to be confident in his/her abilities to identify opportunities in RE market, identify the best venture for the farm, mobilise resources and control financial management of the RE venture compared to another with just secondary school qualifications.

With regards to the effect of the country institutional profile on perceptions of self-efficacy, a positive influence was identified between the regulatory institutional dimension

of the country's institutional profile and perceived self-efficacy (β= 0.17, p= 0.001). Additionally, perceived self-efficacy was strongly influenced by social institutional factors including the cognitive (β= 0.25, p= 0.000) and normative institutional profiles. There was a marginal negative relationship between society's acceptability of entrepreneurship and perceived feasibility (β= -0.07, p= 0.50). Perceived support of family, friends and business networks was positively related to farmers' perceptions of self-efficacy (β= 0.21, p= 0.000). The full part analysis can be found in appendix 12.

4.9.3.2 The influence of independent variables on perceptions of desirability of RE ventures

To assess the potential mediating effect of perceived desirability of RE ventures, the institutional and resource based variables were regressed against the attitudinal variable according to (Baron and Kenny 1986). Path analysis results are presented in table 4.35b.

Table 4.35b: Re-specified proposed mediation model

Independent variable	B	SEE	β	Sig.
(Constant)	2.71	0.205		0.000***
Dum_50	-0.49	0.103	-0.34	0.000***
Dum_50_99	-0.28	0.123	-0.15	0.024*
Dum_100_499	-0.35	0.098	-0.26	0.000***
Regulatory support for RE	0.12	0.055	0.12	0.027*
Cognitive institutional support	0.14	0.051	0.16	0.005**
Adjusted R^2	**0.10**			
F	**8.65*** **			

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

As expected, the level of agricultural business turnovers had a significant influence of farmers' perceptions of desirability. Clearly this also suggests that farmers with higher incomes are more likely to assess RE ventures more favourably. The downside is that

farmers with smaller incomes may be left out in the process of developing the RE sector. Care needs to be taken to target less resource capable farmers as well.

The re-specified model in table 4.35 shows that once again the regulatory institutional dimension positively related to perceived desirability of RE ventures (β= 0.12, p= 0.027). The result shows that farmer perceptions of the favourability or availability of the regulatory institutional environment influence their perceptions of desirability. In effect, this means that government's role may be important in facilitating the emergence and availability of markets and opportunities for investment, assisting organisations to provide targeted support to farmers, facilitating access to financial services from banks and developing consistent policies which are sensitive to the differential characteristics of farmers and their enterprises. A key challenge is to assist farmers to recognise these opportunities and act on them. The results also reveal that the cognitive institutional dimension had a positive influence on perceptions of desirability of investing in RE.

4.9.4 Observed mediation effects

The final stage to confirm mediation according to Baron and Kenny (1986) requires regressing the proposed mediating and independent variables on the dependent variable. According to Baron and Kenny, the effect of the independent variable on intentions should be lower than the effect obtained by regressing the independent variables directly on the dependent variables.

4.9.4.1 Mediation effect of perceived self-efficacy of RE ventures

Full mediation occurs when none of the significant paths obtained in step 1 remain significant. Partial mediation is observed when the level of effects of the independent variables in stage 3 of the Baron and Kenny (1986) procedure remain significant but the effects are diminished.

Results presented in table 4.36 show that variables measuring the resource base of the farmer remain significant with the introduction of the mediating variable. The farmers level of diversification, agricultural contracting (β= -0.15, t= -2.80, p= 0.005), land tenancy status (β= -0.15, t= 2.60, p= 0.010) and the farmer's level of education (β= -0.15, t= -1.97, p= 0.050) maintain a significant influence on farmers intentions. Interestingly, none of the institutional profile variables which were significant (section 4.7.2) remained significant with the introduction of perceived feasibility into the model. This suggests that perceived self-efficacy fully mediates the relationship between cognitive and normative factors on intentions.

Table 4.36: The mediating effect of perceived self-efficacy

Variables	B	SEE		t	Sig.
(Constant)	2.02	0.525		3.84	0.000***
Dummies accommodation	0.28	0.168	0.09	1.66	0.098†
Dummies agricultural contracting	0.45	0.161	0.15	2.80	0.005**
Dummies non-agricultural contracting	0.00	0.225	0.00	0.00	0.999
Dum_whoten	-0.48	0.183	-0.15	-2.60	0.010*
Dum_mainten	-0.16	0.195	-0.05	-0.80	0.422
Dum_mainown	-0.01	0.136	0.00	-0.06	0.952
Dum_50	-0.53	0.197	-0.23	-2.70	0.007**
Dum_50_99	-0.18	0.204	-0.06	-0.86	0.390
Dum_100_499	-0.11	0.165	-0.05	-0.69	0.492
Dum_belowsec	-0.67	0.341	-0.14	-1.97	0.050*
Dum_sec	-0.48	0.248	-0.22	-1.94	0.054†
Dum_uni	-0.27	0.261	-0.11	-1.04	0.298
Dum_5years	0.16	0.476	0.02	0.33	0.743
Dum_14years	-0.15	0.289	-0.03	-0.52	0.602
Dum_24years	0.24	0.201	0.06	1.19	0.237
Dum_solpro	-0.05	0.237	-0.02	-0.20	0.845
Dum_part	-0.04	0.209	-0.02	-0.18	0.859
Regulatory support for RE	0.09	0.094	0.05	0.98	0.327
Regulatory complexity	-0.05	0.067	-0.04	-0.69	0.493
Cognitive institutional support	0.06	0.089	0.04	0.71	0.480
Society's admiration for entrepreneurship	-0.09	0.057	-0.09	-1.65	0.100
Support of friends, family and associational networks	0.04	0.060	0.04	0.66	0.507
Perceived self-efficacy	0.49	0.082	0.36	5.96	0.000***
R	**0.60**				
R^2	**0.35**				
Adjusted R^2	**0.30**				
F change	**35.50*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

The mediation effects of perceived self-efficacy of RE enterprises are presented in table 4.37.

Table 4.37: Direct and mediated effects model of perceived self-efficacy of RE ventures

Variables	Direct effects of institutions		Independent variables and perceived self-efficacy as predictors	
	β	Sig.	β	Sig.
Dummies accommodation	0.12	0.034*	0.09	0.098†
Dummies agricultural contracting	0.17	0.003**	0.15	0.005**
Dummies non-agricultural contracting	0.01	0.858	0.00	0.999
Dum_whoten	-0.16	0.008**	-0.15	0.010*
Dum_mainten	-0.09	0.134	-0.05	0.422
Dum_50	-0.31	0.001***	-0.23	0.007**
Dum_50_99	-0.11	0.121	-0.06	0.390
Dum_belowsec	-0.22	0.003**	-0.14	0.050*
Dum_sec	-0.37	0.001***	-0.22	0.054†
Dum_uni	-0.21	0.054†	-0.11	0.298
Dum_5years	0.05	0.396	0.02	0.743
Dum_solpro	-0.03	0.805	-0.02	0.845
Dum_part	0.01	0.952	-0.02	0.859
Regulatory support for RE	0.06	0.302	0.05	0.327
Regulatory complexity	0.00	0.966	-0.04	0.493
Cognitive institutional support	0.13	0.033*	0.04	0.480
Society's admiration for entrepreneurship	-0.12	0.037*	-0.09	0.100
Support of friends, family and associational networks	0.13	0.046*	0.04	0.507

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Table 4.37 shows the mediation effect of perceived self-efficacy on the impact of institutional and resource based factors on investment intentions. It emerges that perceived self-efficacy fully mediates the relationship between the country's institutional profile and entrepreneurial intentions. This is illustrated by the fact that none of the three significant direct effect variables remain statistically significant when regressed with perceived self

efficacy. Table 4.37 also reveals that perceived self-efficacy partially mediates the effect of farm business resource situation and its influence on RE investment intentions.

4.9.4.2 The mediating influence of perceived desirability of RE enterprises on investment intentions

Table 4.38 shows farm resource characteristics maintain a direct effect influence on farmers' intentions despite the introduction of the mediating variable in the model.

Table 4.38: The mediating effect of perceived desirability of RE ventures

Variables	B	SEE	β	t	Sig.
(Constant)	1.22	0.486		2.52	0.012*
Dummies accommodation	0.39	0.153	0.12	2.54	0.012*
Dummies agricultural contracting	0.51	0.147	0.17	3.47	0.001***
Dum_whoten	-0.54	0.167	-0.17	-3.25	0.001***
Dum_mainten	-0.22	0.177	-0.07	-1.23	0.221
Dum_50	-0.37	0.182	-0.16	-2.02	0.044*
Dum_50_99	-0.15	0.186	-0.05	-0.78	0.435
Dum_belowsec	-0.75	0.308	-0.16	-2.43	0.016*
Dum_sec	-0.53	0.222	-0.24	-2.39	0.018*
Dum_uni	-0.20	0.237	-0.08	-0.84	0.399
Dum_5years	0.26	0.433	0.03	0.60	0.547
Dum_solpro	-0.08	0.217	-0.03	-0.37	0.713
Dum_part	-0.01	0.191	-0.01	-0.06	0.951
Regulatory support for RE	0.05	0.086	0.03	0.55	0.585
Regulatory complexity	-0.02	0.061	-0.01	-0.29	0.775
Cognitive institutional support	0.05	0.080	0.03	0.65	0.514
Society's admiration for entrepreneurship	-0.13	0.052	-0.13	-2.52	0.012*
Support of friends, family and associational networks	0.10	0.054	0.10	1.87	0.063†
Perceived desirability of RE ventures	0.74	0.077	0.48	9.65	0.000***
R	**0.68**				
R^2	**0.46**				
Adjusted R^2	**0.41**				
F change	**93.10*** **				

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

These results suggest that the cognitive institutional factors only influence intentions to the extent that they affect farmers' perceptions regarding the availability of markets and the viability of RE enterprises. Table 4.39 shows the summary of the mediation effects of perceived desirability.

Table 4.39: Mediation effect of perceived desirability

Variables	Direct effect of institutions		Institutions and perceived desirability as predictors	
	B	Sig.	β	Sig.
Dummies accommodation	0.12	0.034*	0.12	0.012*
Dummies agricultural contracting	0.17	0.003**	0.17	0.001**
Dum_whoten	-0.16	0.008**	-0.17	0.001**
Dum_mainten	-0.09	0.134	-0.07	0.221
Dum_50	-0.31	0.001***	-0.16	0.044*
Dum_50_99	-0.11	0.121	-0.05	0.435
Dum_belowsec	-0.22	0.003**	-0.16	0.016*
Dum_sec	-0.37	0.001***	-0.24	0.018*
Dum_uni	-0.21	0.054†	-0.08	0.399
Dum_5years	0.05	0.396	0.03	0.547
Dum_14years	0.00	0.958	0.00	0.961
Dum_solpro	-0.03	0.805	-0.03	0.713
Dum_part	0.01	0.952	-0.01	0.951
Regulatory support for RE	0.06	0.302	0.03	0.585
Regulatory complexity	0.00	0.966	-0.01	0.775
Cognitive institutional support	0.13	0.033*	0.03	0.514
Social acceptability of entrepreneurship	-0.12	0.037*	-0.13	0.012*
Support of friends, family and associational networks	0.13	0.046*	0.10	0.063†

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

It emerged that farmers are likely to identify opportunities for investment when there is shared knowledge about RE, where farmers know where to find relevant information regarding markets, policies, financial incentives and other types of support. The lack of or

inadequacy of skills development structures is unlikely to lead to a situation where identified opportunities are actually implemented. The mediation effect on normative support of networks of family also indicates that these social networks influence farmers' investment intentions in as much as they assist individual farmers to identify and implement opportunities in the RE sector which at the same time provide economic and social welfare benefits.

4.10 Full Linear Model: The factors affecting farmers' intentions to invest in RE enterprises

The objective of this section was to test two hypotheses relating to the mediating effect of perceived feasibility and desirability on two sets of independent variables: the farm resource base variables and country institutional profile variables. Results in sections 4.9.3.3.1 and 4.9.3.3.2 show that perceived self-efficacy and desirability mediate the effect of external factors in different ways. Despite the strong mediating effects of these variables, a number of unexpected results are obtained (table 4.40). First, the types of diversification activity undertaken by the farmer and the land tenancy status have direct influences on farmers' intentions. These are interesting findings as they suggest that these may be critical or tip off points for farmers when they consider investing in RE enterprises. For example, no matter how attractive and feasible RE ventures might be, a farmer on a mainly tenanted or fully tenanted farm may never commit the land to RE ventures which are known for very long payback periods. Additionally, what the farmers may be able to do on the farm will be influenced by agreements with the landlord (Maye *et al.* 2009).

Secondly and contrary to expectation, the linear regression analysis showed that society's admiration for entrepreneurship had a negative unmediated influence on investment intentions.

Table 4.40: Factors affecting farmers' intentions to invest in RE enterprises

Variables	B	SEE	β	t	Sig.
Constant	3.47	0.268		12.91	0.000***
Dummies accommodation	0.31	0.147	0.10	2.12	0.035*
Dummies agricultural contracting	0.46	0.140	0.15	3.30	0.001***
Dummies non-agricultural contracting	0.04	0.196	0.01	0.21	0.834
Dum_whoten	-0.51	0.160	-0.16	-3.17	0.002**
Dum_mainten	-0.11	0.170	-0.03	-0.63	0.530
Dum_mainown	0.05	0.119	0.02	0.46	0.649
Dum_50	-0.26	0.174	-0.11	-1.49	0.139
Dum_50_99	-0.04	0.179	-0.01	-0.22	0.829
Dum_100_499	0.06	0.145	0.03	0.45	0.657
Dum_belowsec	-0.47	0.298	-0.10	-1.59	0.113
Dum_sec	-0.29	0.217	-0.13	-1.33	0.186
Dum_uni	-0.03	0.229	-0.01	-0.14	0.889
Dum_5years	0.06	0.415	0.01	0.15	0.878
Dum_14years	-0.11	0.252	-0.02	-0.45	0.653
Dum_24years	0.14	0.176	0.03	0.77	0.441
Dum_solpro	-0.07	0.207	-0.03	-0.32	0.748
Dum_part	-0.05	0.182	-0.02	-0.26	0.792
Regulatory support for RE	0.02	0.054	0.02	0.44	0.662
Regulatory complexity	-0.04	0.050	-0.04	-0.89	0.374
Cognitive institutions	-0.03	0.056	-0.02	-0.45	0.653
Society's admiration for entrepreneurship	-0.11	0.051	-0.10	-2.15	0.033*
Support of friends, family and associational networks	0.04	0.053	0.04	0.70	0.483
Perceived self-efficacy	0.29	0.057	0.27	5.17	0.000***
Perceived desirability	0.46	0.051	0.43	9.09	0.000***
R	**0.72**				
R^2	**0.51**				
Adjusted R^2	**0.48**				
F change	**64.63*** **				

Level of significance: *p < 0.05, ** p< 0.01, ***p< 0.001

It is interesting to also highlight that the β coefficients for regulatory complexity and cognitive institutions are negative in the full model research model. This finding supports the argument that an unsupportive institutional environment would affect intentions

negatively and therefore behaviour. If farmers realise that the regulatory environment is complex and the knowledge structures are potentially unsupportive, e.g. because they think that the procedural requirements for investment are too many, or because it is too expensive to obtain planning permission for setting up RE ventures, or that they do not have access to adequate training and skills development opportunities, they are less likely to develop positive intentions towards RE production. The important issue is that these perceptions can be changed and improved by reducing red tape or by introducing suitable skill development initiatives (Luthje and Franke, 2003).

The full model shows a predictive power of 0.48 suggesting that our predictors explain 48 percent of the variance in the dependent variable. This level of prediction is good when compared to studies in entrepreneurship (e.g. 0.23 by Rotefoss and Kolvereid (2005), 0.34 by Lee *et al* (2011), 0.32 by Kostova and Roth (2002), 0.40 by Krueger *et al* (2000), farm entrepreneurship (0.22 by Vesala *et al* (2007) and RE adoption (e.g. 0.16 by Meek *et al* (2010), 0.35 by Masini and Menichetti (2012), 0.45 by Mattison and Norris (2007) using the TPB) research more specifically.

The predictive power of this model also means that in effect, taken alone, institutional factors play a limited direct role in influencing farmers' investment behaviour. The findings indicate and provide support for the process based model of intention and show that attitudes towards entrepreneurship play a far more important role in influencing intentions and consequently behaviour rather than institutional and resource based factors.

4.10 Chapter summary and link to chapter 5

The aim of this chapter was to present results of findings of the postal questionnaire survey of farmers in the West Midlands of the UK. There were five study aims which covered the major issues surrounding the adoption of RE enterprises on UK farms.

The results showed that of the 393 usable questionnaires retained for analysis, 55 (14%) out of the 393 survey participants had adopted some form of RE enterprise. Of the 55 survey participants with operational RE ventures at the time of the study, 44% said that farm business performance remained the same after adoption, 52% of current adopters reported slight to significant improvements in farm business performance in 2009. In financial terms, up to 24% were unsure of the financial value of the contributions brought about by RE. Up to 35% of respondents reported farm business turnovers of between £1-£10,000 while another 2% suggested that the contribution of RE could be estimated at above £25,000 turnover in 2009.

Further analysis revealed that solar energy ventures were the most popular types of ventures reported followed closely by biomass boilers fired by on-farm biomass or off-farm woodchip/pellets while some 13% had wind turbines on farms. The occurrence of other biomass related enterprises was quite evenly spread out amongst adopters. Energy crops (Miscanthus and short rotation coppice) were adopted by 9 out of the 55 survey participants. Anaerobic digestion was the least adopted RE enterprise because of the higher initial outlays required and the planning/permitting requirements for setting up this particular type of enterprise.

It emerged from the current study that farmer' investment decisions are guided by entrepreneurial motives as a means to improve the viability of enterprises through

diversified RE markets. To diversify farm incomes, cut farm business costs, take advantage of market opportunities and provide environmental benefits were the most important reasons for adoption (possible adoption). Taking advantage of government grants was a more frequent response from current non-adopters than actual adopters. Helping to meet government energy and climate change targets was not viewed as being very significant while there was even less emphasis on the ability of RE enterprises to assist disposal of farm waste. Other motives such as preparing for retirement, ensuring long term financial security, making use of existing farm resources as well as improving social acceptability of the farm enterprise were also highlighted by survey participants.

An analysis of 193 responses relating to investment constraints showed that some broad categorisation of the barriers into economic, regulatory, cognitive and normative groups was adequate. As regards economic barriers, high investment costs, unsuitable farm situation, tenancy, unsure economic benefits and long payback periods were the most significant barriers raised. The most important regulatory problem raised related to planning, red tape and lack of trust in government policy while cognitive barriers were the lack of information about different financial support packages, lack of knowledge and skills and finally the "unproven" nature of some RE technologies. Old age and lack of social acceptability of RE enterprise (visible impacts, public/neighbour opposition) were seen as additional barriers for investment.

Part 3 and 4 presented results of the factors which have an influence on farmers' intentions to investment in RE enterprises. Results showed that the model developed was robust and explained a significant proportion of the variance in the independent variable. It emerged that farmers' attitudes had the most significant influence on intentions and as proposed in the model (section 2.8.4 chapter 2), and mediated the relationships between external factors and farmers' investment intentions.

Chapter 5 will discuss the results of this study in line with extant literature in order to further evaluate the standing of the results with regards to established research. It presents areas of agreement between findings from this thesis and other research but also contradictions and differences. By so doing, the practical, research and theoretical contributions of this study are further illustrated.

Chapter 5: Discussion and implications for research, theory and practice

5. Introduction

This chapter presents discussions of the results of the postal questionnaire survey of farmers in the West Midlands Region of the UK as described in chapter 3. This study was carried out with the following aims:

1. To investigate the level of deployment of RE on UK farms;
2. To investigate the contribution of RE to farm business performance;
3. To assess the types of RE ventures available to farmers;
4. To assess the motivations for adoption and the constraints which hinder greater penetration of RE in the UK farm sector; and
5. To determine the factors which influence future behaviour regarding farmers' intentions to invest in RE enterprises

Chapter 4 presented the results of the study and the extent to which the above mentioned objectives were achieved. In chapter 5, these results are discussed identifying contributions to knowledge and implications for research, theory and practice. Sections 5.1 will deal with the theoretical and research implications of the study while section 5.2 will discuss the policy implications of the results. The chapter ends with a summary section and creates the link to chapter 6.

5.1. Theoretical and research implications of the study

5.1.1. Incidence of RE enterprises in the UK Farm Sector

This study showed that of the 393 usable questionnaires retained for analysis in this thesis, 55 (14%) out of the 393 survey participants had adopted some form of RE enterprise. Of the 55 survey participants with operational RE enterprises at the time of the study, 44% said that farm business performance remained the same after adoption, half of them reported slight to significant improvements in farm business performance in 2009. In financial terms, up to 24% were unsure of the financial value of the contributions brought about by RE. Up to 35% of respondents reported contributions of between £1- £10,000 while another 2% suggested that the contribution of RE could be estimated at above £25,000 turnover in 2009.

It was found that solar energy ventures were the most popular types of enterprises reported followed closely by biomass boilers while some 13% had wind turbines on farms. The occurrence of other biomass related enterprises was quite evenly spread out amongst adopters. Energy crops (Miscanthus and Short rotation coppice) were adopted by 9 out of the 55 survey participants. Anaerobic digestion was the least adopted RE enterprise, possibly because of the higher initial outlays required and the planning/permitting requirements for setting up this particular type of enterprise. Most adopters used personal savings (38%) and business reserve funds (34%) in order to invest in RE. Only 7% accessed government financial support while 5 others obtained funds from family sources. It was found that mainly owned farm businesses above 100ha and above were the most represented to have accessed loans from banks. They were also more likely to report using business resources. None of the farmers below 35 received loans or grants for investment. Younger farmers were less likely to have access to formal sources of finance and therefore unlikely to find investment in RE feasible even if seen to be personally desirable. The implications of these results are presented in the following sections.

In the quantitative survey, it was reported that less than 15% of respondents had some form of RE enterprise on the farm which is higher than 4.7% for the West Midlands and 4.8% nationally identified by the June Census of Agriculture and Horticulture for the period between July 2009 and June 2010 (DEFRA, 2012).This difference is likely to be because the current study was interested in an inventory of all operational RE enterprises on the farm while the DEFRA 2010 survey was focused for the 2009-2010 period.

Other studies have tended to focus on specific RE enterprises. It is fair to state that most of the studies on adoption of RE on farms, have tended to focus on investments in energy crops (Sherrington *et al.* 2008, Clancy *et al.* 2008, Clancy *et al.* 2011, Ericsson *et al.* 2009, Panoutsou 2008, Roos *et al.* 1999, Rösch and Kaltschmitt 1999, Rosenqvist and Dawson 2005) and very recently anaerobic digestion (Tranter *et al.* 2011) and wind (Munday *et al.* 2010) but little is known about the strategic preferences of farmers regarding other types of enterprises. A common conclusion that has emerged from the above mentioned studies is that the rate of uptake of these enterprises in the farm sector is low and that government targets are unlikely to be met. For example, Sherrington *et al* (2008) in a study of farm level constraints regarding the uptake of energy crops in the UK found that out of 28 farmers taking part in the focus group study about 50% had experience of growing short rotation coppice. Understandably this high incidence was the result of a biased selection process which recruited participants from an area close to biomass energy plants. In a recent study on anaerobic digestion in the UK, Tranter *et al* (2010) did not find any adopters out of the 384 farmers responding to their mail survey.

The adoption rate of 14% in this research is in line with the low rates of deployment reported in past research but is higher than the 5% adoption rate reported by DEFRA (2012). The 14% rate of adoption also masks the specifics regarding the types of enterprises that are of interest to farmers. Further analysis revealed that that the rate of

uptake of anearobic digesters and energy crops (Miscanthus and short rotation coppice - SRC) production was very low compared to solar energy production. When the strategic interests of potential adopters were analysed, it also emerged that wind and solar were the most popular RE ventures of interest to respondents. This finding supports the results obtained by DEFRA (2012) and Masini and Menichetti (2012). There are a number of potential reasons for these findings (Mbzibain *et al.* 2011, Tate *et al.* 2012 forthcoming): differential public support for specific technologies, government policy influence and farm management considerations.

Firstly, Segon *et al* (2004) in a study of public attitudes towards RE, found that the UK public had differentiated support for RE enterprises. They found that 72% out of 840 respondents surveyed were in support of wind energy with the majority (75%) in support of solar. Only 16% of respondents were in support of biomass based systems, the authors noting that this was largely because of a lack of understanding of the technology being applied. Similar arguments have been put forward through results obtained by research underpining the public perception of energy crop production in the UK by the Rural Economy and Land Use Programme (The Rural Economy and Land Use Programme, 2009). The programme research report showed that the UK public does not oppose bioenergy enterprises but is more concerned about increased traffic that might ensue from the development of biomass energy plants in their neighbourhoods. While there appears to be uncertain support for biomass related enterprises, farmers may be more interested in enterprises with higher chances of public acceptance.

A second reason for the strategic preferences of survey participants may come from the introduction of the Feed In Tariffs in 2010 and the Renewable Heat Incentive in 2011. The introduction of the RHI and the FITs mean that farmers may derive more benefits from energy generation (DECC, 2010b).

Thirdly, the adoption of energy crops is often constrained by lack of flexibility, opportunity costs of traditional agricultural enterprise, tied up contracts as well as costs of returning the land to other uses (Sherrington *et al.* 2008). Other enterprises such as solar seem to offer flexibility to the farming participants as they may not directly compete with other traditional agricultural activities for land. Recent evidence from research carried out in Wales by Munday *et al* (2010) also suggests that farmers may be willing to lease out portions of their land for wind development. Where such lease arrangements are possible, farmers may take part in joint ventures by contributing land for wind farm development. Solar and wind may not directly compete with traditional agricultural activities and so farmers with smaller agricultural farm sizes may as well participate in RE generation. Information provided on the strategic preferences of farmers is significant in that it questions the UK biomass strategy (2012) and its potential to scale up adoption of biomass related enterprises in the UK (Sherrington *et al.* 2008, Clancy *et al.* 2011, DEFRA, 2012).

Another issue which emerged from analysing the experiences of early adopters of RE on farms revealed that only a small proportion of adopters had access to any form of bank assistance or government financial support. The results suggested the weak role that formal clearing banks play in providing capital for RE projects. Further analysis suggested that access to bank credits and government subsidies was biased towards farmers operating larger farms and also having higher levels of educational attainments. It emerged that a farmer's resource base was an important determinant with regards to access to financial resources. Past research has shown that credits from banks are not easy to obtain for RE enterprises because of technical and non technical uncertainties, lack of confidence, and the fact that private financing institutions lack information about the technologies (Roos *et al.* 1999). In the same direction, McCormick and Kåberger (2007) showed that a lack of understanding of the technologies by bank staff was a key barrier to access credits for RE

ventures. Other researchers have suggested that banks often argue that diversification dilutes managerial skills on existing enterprises, increasing risks of failure-default (Grant and MacNamara, 1996) meaning that banks may think individuals do not have the necessary skills to lead viable RE ventures.

The finding that most current adopters made use of their personal savings is in line with entrepreneurship research on new venture creation (Shapero and Sokol, 1982). Results showed that respondents also made use of family, friends and relatives to obtained financial resources. In their study of social dimensions of entrepreneurship, Shapero and Sokol (1982), suggested that most individuals make use of personal savings and savings from relatives to start new companies. They argued that family is often used to obtain financial resources, moral support, labour, and necessary skills facilitating venture feasibility. This study also found that adopters had limited access to government grants and subsidies. Access to state grants was influenced by the farmer's level of education, farm business size and levels of agricultural business turnovers, which concurs with the results of past research on farmers' attitudes towards grant schemes in the UK (Ilbery *et al.* 2009).

5.1.2. Motivations and barriers to adoption

This study found that farmer' investment decisions were guided by entrepreneurial motives as a means to improve the viability of enterprises through diversified RE markets. To diversify farm incomes, cut farm business costs, take advantage of market opportunities and provide environmental benefits were the most important reasons for adoption (possible adoption). Taking advantage of government grants was more likely to be raised by current non-adopters than actual adopters. Helping to meet government energy and climate change targets was not viewed as being very significant while there was even less emphasis on the ability of RE enterprises to assist disposal of farm waste. Other motives such as preparing for retirement, ensuring long term financial security, making use of existing farm resources

as well as improving social acceptability of the farm enterprise were also highlighted by survey participants.

An analysis of 193 responses relating to investment constraints showed that some broad categorisation of the barriers was adequate. Close to half of the responses obtained were identified to be economic in nature, 45 were related to regulatory/cognitive issues, while the rest were related to normative and social acceptability of RE enterprises. As regards economic barriers, high investment costs, unsuitable farm situation, tenancy, unsure economic benefits and long payback periods were the most significant barriers raised. Lack of market outlets, high commodity prices and difficult access to credit were surprisingly the least important barriers reported.

The most important regulatory problem raised related to planning, red tape and lack of trust in government policy while cognitive barriers were the lack of information about different financial support packages, lack of knowledge and skills and finally the "unproven" nature of some RE technologies. Old age and lack of social acceptability of RE enterprise (visible impacts, public/neighbour opposition) were seen as additional barriers for investment. A few other farmers suggested that they could not take on additional enterprises because of lack of management time.

As indicated earlier, cost reduction, closely followed by a desire to diversify farm incomes were the most significant motivating factors for adoption for adopters and non-adopters. Even though these responses seemed to suggest economic centrality, past research showed that people do start their enterprises for a variety of reasons other than growth or maximizing economic returns (Edelman and Yli-Renko, 2010). Taking advantage of market opportunities, providing support to reach government targets and accessing government grants and subsidies were also revealed as key drivers for adoption/potential

adoption. The motivations for adoption, proffer support to very recent research by Adams *et al* (2011). They found that the four most important drivers according to farmers adopting biomass were profitability, willingness to assist meet government targets, market diversification as well as the need to reduce dependency on fossil fuels. Another survey by Tranter *et al* (2010) looking at possible benefits from adopting anaerobic digestion, showed that improved farm profit, reduced pollution/contamination risk as well as reduced farm's carbon footprint were important benefits for potential adopters.

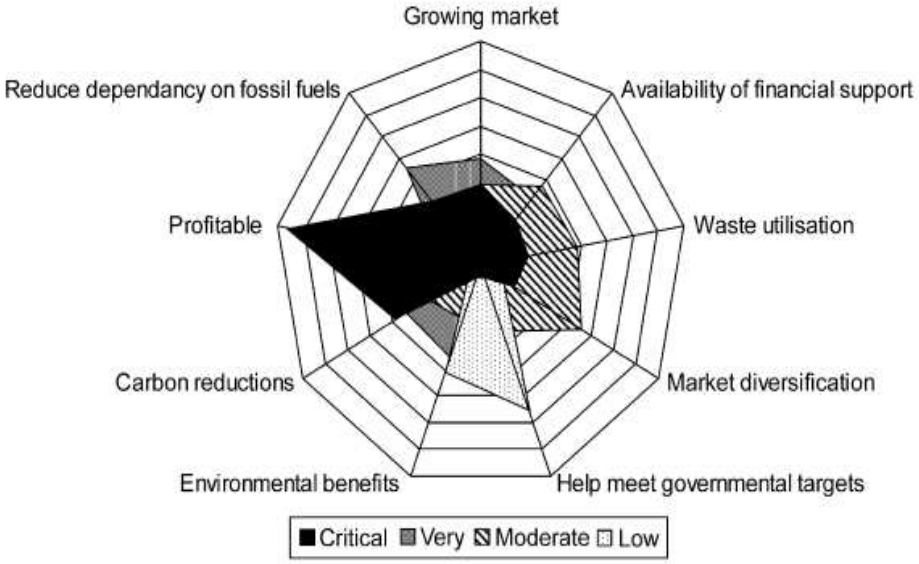


Figure 5.1: Motivations for adoption
Source: Adams *et al* (2011)

The motivations for adoption of RE enterprises in the UK concur with those shown in Figure 5.1 reported by Adams *et al* (2011). When compared to past research on agricultural diversification, the motivations for investing in RE are supportive of those obtained by Bowler *et al* (1996) in their study of the development of alternative farm enterprises in the North Pennines of the UK. They reported that the need to maintain or increase incomes (63%), reacting to a market opportunity (22%), exploiting an underutilized farm resource (22%) and need to create employment (16%) were the most important motives for diversification. Similar to this study, adoption of state grant aid was found to be relatively

unimportant to the development of alternative farm enterprises. Past research has also found similar results including Evans (2009) who found that the main objectives for diversification in a UK sample of farmers included the need for extra income, exploitation of market opportunities, lack of agricultural alternatives and personal interests.

Diversification activities tend not to make significant contributions to overall business performance (McNally, 2001). RE production has the potential to improve the economic performance of the farm business through cost savings and energy efficiencies. While the direct financial benefits to the farmer may be low (between £1- £25,000) as shown in section 5.1.1, RE production may also lead to social benefits, which if quantified, can be substantial. With regards to social benefits, providing environmental benefits and helping government to achieve environmental targets ranked highly as a motivation for adoption suggesting that farm entrepreneurship can play an important role in providing social welfare benefits (Dean and McMullen, 2007, Hall *et al.* 2010, York and Venkataraman, 2010) by investing in enterprises for profit which at the same time generate social welfare benefits such as reducing pollution, climate change mitigation, reduction of fossil fuel use as well as CO_2 emission reductions (Sutherland, 2010). Unfortunately, these social benefits are often not included in models about the viability of RE enterprises (Roos and Rakos, 2000) and as such a common conclusion which emerges from studies comparing the viability of traditional agricultural and RE enterprises, is that RE is not viable in the absence of a grant/subsidies regime (Sherrington and Moran, 2010, Adams *et al.* 2010). Grants and subsidies might be considered as compensation for the positive externalities that are created through RE production which in many cases is not justifiable on purely economic terms (Nix, 2012).

As mentioned earlier, adoption of grant aid was not the most important motivating factor raised by farmers in this survey. Bowler *et al* (1996) realised that access to government

subsidies was a relatively less important driver for the development of alternative farm enterprises in the UK. Similar research on the impact of subsidy payments on the adoption of agricultural farm practices in Germany showed that subsidy payments were not always the most important factor for farmers when evaluating adoption of a farm practice. That farmers were ready to risk huge personal and business financial resources as shown in this thesis is contrary to earlier studies which have emphasised that farmers would not invest in RE in the absence of government subsidies (Clancy *et al.* 2008, Clancy *et al.* 2011, Sherrington *et al.* 2008, Sherrington and Moran, 2010). Government intervention remains a key factor in the development of the RE market in Europe even though experience with government intervention varies across countries (Thornley and Cooper, 2008).

In a recent UK study of barriers to and drivers for UK bioenergy development researchers identified four stakeholder groups and proceeded to compile lists of barriers and drivers from existing literature (Adams *et al.* 2010). Farmers and biomass suppliers identified the ability to 'make a profit' as the most popular driver and demonstrated the necessity of having economic viability as a sound basis for investment. Other significant drivers included the long term attractiveness of the potential of a growth market, contribution to climate change mitigation and the replacement of fossil fuel sources. Barriers to the development of bioenergy projects included technology, development and operational costs and the impact of legislation. Similar results were obtained with regards to the adoption of anaerobic digesters in the UK where it was found that perceived high capital costs coupled with doubtful overall financial viability were key barriers (Tranter *et al.* 2011).

5.2. Factors influencing farmers' investment intentions

5.2.1 The effect of the farm resource base on investment intentions

Intentions consistently and robustly predict planned behaviours and as such understanding the antecedents of intentions implies understanding the behaviour (Krueger and Brazeal, 1994, Krueger, 1993, Krueger *et al.* 2000, Kim and Hunter, 1993). This research argued that investment intentions were determined by the interaction between three factors (the environment, the individual attitudes/cognitions and the interrelationships between the individual and others) in line with Social Cognition Theory and established Planned Behaviour Theories (Azjen, 1991, Bandura, 1977b, Bandura, 1989, Bandura, 1999, Shapero and Sokol, 1982, Shapero, 1984).

This section is devoted to evaluate intentions of current non-adopters. Current non-adopters were asked three questions regarding their interest in RE enterprises, how much consideration they had given to this type of enterprise and finally whether they were going to try to set up RE on their farms within the next five years. On the last question, 66% of 338 respondents said they were likely to set up RE on their farms. These survey participants were referred to as potential adopters while the remaining 34% were referred to as non-adopters. A key research objective was then to evaluate the areas of difference between the potential and non-potential adopters.

Potential adopters were more likely to have larger farm sizes, higher agricultural business turnovers, better educated, younger, operating mainly on partly owned or fully owned farms and running either family partnerships or limited companies. Non-adopters tended to be older, had smaller farm sizes, lower agricultural business turnovers, lower educational attainments, on tenanted farms and operating mainly as sole proprietors.

Potential adopters were more positive in their evaluation of the favourability of the institutional environment. All non-adopters evaluated the cognitive environment as well as local council support such as the sympathetic consideration of planning consent to be seriously lacking for RE development. It emerged that potential adopters thought they had support of family, friends and business networks (mean score 3.25) more than non-adopters (mean 2.90) in case they decided to invest in RE production.

Additionally, potential adopters appeared to be more confident (mean 3.56) in their abilities to identify market opportunities, mobilise necessary resources and set up RE enterprises more than non-adopters (mean 2.95). Similarly potential adopters were more likely to perceive that investing in RE was personally desirable (mean 3.35) well above the levels of desirability observed amongst non-adopters (mean 2.81) meaning that potential adopters thought RE was a viable business proposition compared to existing agricultural enterprises.

Though no significant effect of age on investment intentions was observed in this study, the result that younger farmers were more likely to have positive intentions is in line with current research. For example, Jensen *et al* (2007) found a negative relationship between farmers' willingness to invest in RE crops and age in the United States while similar results were reported for potential adopters of anaerobic digestion in the UK farm sector (Tranter *et al.* 2011). If RE is considered as an agricultural innovation, alternative farm enterprise or a form of diversification, results of this study are strongly in line with other recent studies on farmers' behaviours regarding the setting up of new enterprises on farms (Bowler *et al.* 1996, Burton *et al.* 1999, Damianos and Skuras, 1996, Evans 2009, Jones 2006, Martin *et al.* 1997, McNally, 2001).

Multivariate regression analysis results showed that the level of educational attainment of the respondent was a strong positive and significant predictor of intentions. These results are in line with other recent studies that have linked higher levels of education with willingness to invest in renewable energy (Jensen *et al.* 2007, Clancy *et al.* 2008, Tranter *et al.* 2011). Higher levels of education are also positively related to rates of diversification on farms (Anosike and Coughenour, 1990). The argument is that more educated farmers have high information processing abilities and may facilitate the use of more complicated management tools thereby enhancing risk taking and diversification.

Literature on the influence of tenure on the introduction of new farm activities is sparse (Maye *et al.* 2009). Modeling the influence of tenure on investment intentions showed that it was a strong predictor of intentions as farmers on wholly tenanted premises were 17 times less likely to report positive intentions towards RE. Even though in support of Jensen *et al* (2007) the results differ in that they clearly show the levels of influence by type of tenure on willingness to invest by type of tenancy. Earlier studies on agricultural diversification also reported lower rates of diversification on tenanted farms (McNally, 2001). Past research argues that many landlords permit farmers to engage in new farm businesses, but will not permit activities which they may consider as being radical (Maye *et al.* 2009, Jensen *et al.* 2007). The importance of the landlord's consent may therefore be critical in facilitating the uptake of RE enterprises on farms. In view of the potential problems that may arise from tenants investing in RE, potential investors for example need to submit a consent form from the landlord when they apply for energy crop establishment grants from the Natural England Programme (2009). It is also likely that the long pay back periods as well as agronomic issues associated with RE enterprises especially energy crops (25 years on the fields) make insecure tenure a key barrier to investment (Sherrington *et al.* 2008). The results presented here suggest that energy crops may not be the best RE option for tenant farmers. The adoption of energy crops is often constrained by lack of flexibility,

opportunity costs of traditional agricultural enterprise, tied up contracts as well as costs of returning the land to other uses (Sherrington *et al.* 2008). Other enterprises like solar seem to offer flexibility to the farmer participants as they may not directly compete with other traditional agricultural activities for land. Recent evidence from research carried out in Wales (Munday *et al.* 2010) also suggests that farmers may be willing to lease out portions of their land for wind development. Solar and wind may not directly compete with traditional agricultural activities and so farmers with smaller agricultural farm sizes and insecure tenure may as well participate in RE generation.

The finding that farmers with higher business turnovers were more likely to have positive intentions is logical because higher incomes may facilitate access to financial resources and enhance farmers' perceptions of feasibility of RE ventures (Shapero and Sokol, 1982). The relationship between farm size and additional business development is important because it highlights the trade-offs between risk reduction and the possible gains/losses that can accrue given the existing size of the farm (Anosike and Coughenour, 1990). This study did not find any significant relationship between the type of farm business ownership status and intentions. However, Anosike and Coughenour (1990) argue that partnerships and companies may have more managerial resources and hence may be more likely to take up additional businesses than sole proprietorships. Though significant effects did not emerge from this study for the effect of farming system and intentions, earlier research suggests that cereal farms are more likely to adopt energy crops than those involved in milk/cattle production (Rosenqvist *et al.* 2000). It is argued that this is because dairy farms tend to be more labour intensive as activities are carried out all year round which increases the opportunity cost of change (McNally, 2001).

An important contribution of this research to energy policy research is the fact that this study found a significant positive effect of the level of farm business diversification and

the farmer's intention to invest in RE production and associated enterprises. The fact that the dummy variable measuring diversification into agricultural contracting was a consistent predictor of investment intentions argues for the need for research (Clancy *et al.* 2011, Clancy *et al.* 2012, Tranter *et al.* 2010) to integrate this dimension into research about RE production adoption on farms. Farmers involved in agricultural contracting are more likely to have additional skills resources which may facilitate their ability to take on additional investments than non-diversified ones.

The results in this study point to the fact that policy makers cannot consider farmers as a homogenous category. Government policies and programmes stand to yield higher benefits through targeting different groups of individuals with tailored/specific instruments (Alsos *et al.* 2003, Reynolds *et al.* 1994, McElwee, 2006).

5.2.2 Influence of the country institutional profile on intentions to invest in RE

Hypotheses two and three of this research were developed to test how farmers' perceptions of the country's institutional profile influence investment intentions. Multiple regression analysis showed that these hypotheses were supported as shown in table 5.1.

Table 5.1: Summary results: hypotheses 2 and 3

Hypotheses	Expected sign	Relationship
H2a,b: Regulatory institutional dimensions	+/-	No relationship
H2c: Cognitive institutional dimension	+	Positive *
H2d,e: Normative institutional dimension	+	
• Society's acceptability of entrepreneurship	+	Negative*
• Support of family, friends and associational networks	+	Positive*
H3: Regulatory X normative institutions	+	Positive*

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Firstly, the results show that the regulatory institutional dimension (regulatory support and regulatory complexity) was not directly related to investment intentions. Secondly, results emerging from the analysis showed that there was a positive relationship between the cognitive institutional environment and investment intentions. This suggested that farmers viewing the environment as favourable were 13% more likely to develop positive intentions towards RE investment.

Third, mixed results were obtained for the influence of the normative institutional dimension on farmers' intentions as a result of the two underlying normative aspects. On the first aspect of the normative institutional environment relating to general society's acceptability of entrepreneurship, the results obtained were contrary to expectation. The study found a negative relationship between society's acceptability of entrepreneurship and intentions to invest in RE enterprises. On the second aspect relating to the normative institutional profile, it emerged that perceived support of family, friends and business networks had a significant positive influence on entrepreneurial intentions.

Overall, it can be said that what really matters for positive RE investment intentions to develop, is a favourable cognitive and normative environment (Kostova and Roth, 2002). It shows that informal institutions may play a far more important role in promoting the development of RE than has been previously thought. Informal rather than formal institutions may therefore be critical for future development of a farm driven RE sector. Formal institutions may influence intentions only indirectly. In effect, results confirmed this hypothesis as it emerged that the regulatory institutional profile would only be efficacious at different levels of normative institutional support.

The existence of a positive interaction effect showed that social acceptability of entrepreneurship played an important supplementary role on the effect of formal policies on farmers' investment intentions. This is an important contribution of this study to institutional theory and research practice. From the interaction graph (figure 4.13 chapter 4) it emerged that intentions would decrease with decreasing social acceptability of entrepreneurship even with high levels of government support for entrepreneurship. Intentions were also positive with higher levels of social acceptability and government and local council support.

5.2.2.1 The influence of the regulatory institutional dimension on intentions

The **regulatory** pillar of the institutional theory of entrepreneurship is primarily driven by the provisions of government legislation, industrial agreements and standards (Bruton *et al.* 2010). Busenitz *et al* (2000) defined this dimension as consisting of laws, regulations and government policies which provide opportunities, support for businesses, reduces risks and eases entrepreneurs' efforts to acquire production resources. Other researchers define the regulatory dimension as consisting of formal institutions including finance, government policies, government programmes, research and development transfer, market openness, physical infrastructure and intellectual property rights (Alvarez *et al.* 2011). According to

Bowen and De Clercq (2007) this institutional dimension refers simply to the role of the state. Based on the approach adopted by Bowen and De Clercq (2007) this research developed two regulatory constructs with possible influence on investment intentions: Regulatory support for RE and regulatory complexity. The first relating to the extent to which the regulatory framework is supportive of RE development and the second related to the degree of regulatory complexity involved in the process of setting up and managing RE ventures. According to Bowen and de Clercq (2007), regulatory complexity refers to the paperwork and administrative formalities that entrepreneurs must confront in the venture creation process. They may act as a barrier to firm expansion and growth. Items to measure these institutional dimensions were developed based on the works of Busenitz *et al* (2000), Kostova and Roth (2002), Bowen and de Clercq (2007) and Prieto *et al* (2010). Principal component analysis and reliability analysis showed that the constructs developed were uni-dimensional and had good internal reliabilities.

Before delving into detailed analysis of the influence of these institutional aspects on intentions, simple bivariate correlation analysis showed surprisingly that these two regulatory aspects were not related to investment intentions. It also emerged that regulatory support and regulatory complexity aspects were not significantly related to each other and the sign of the correlation was negative which was in agreement with earlier findings by Bowen and de Clercq (2007) in their study of the influence of institutional context on the allocation of entrepreneurial efforts.

To evaluate the influence of the regulatory aspects on intentions, this research asked respondents to assess the levels of regulatory support and complexity involved in the RE investment process. Examining the mean values for adopters and non-adopters, results showed that non-adopters rather than adopters perceived the current regulatory environment as potentially supportive which appeared to be counterintuitive. The likely

extension of the RO mechanism to 2037; the development of a Renewable Heat Incentive (RHI), the Microgeneration Scheme and Feed in Tariffs have been proposed as a means to develop small scale RE projects, improve investor confidence and reduce risk inherent in the other instruments. While policy makers hope that these new initiatives will boost RE development, it is unclear how these policy instruments will be perceived by investors and what factors can effectively facilitate or impede their effective implementation and adoption on the farm. So far, knowledge of the views of entrepreneurs with regards to their experiences of public support and their need for such support has been very limited (Normann and Klofsten, 2009).

Baldegger (2012) argued that even if research has provided information about the role of institutions in promoting entrepreneurship, very little is known about entrepreneurs' perceptions of the institutions and how this translates to venture creation. It was suggested that an analysis of the perspectives of the entrepreneur was likely to improve understanding of the real effects of the institutional environment on entrepreneurial activity. This study contributed to fill this gap by showing entrepreneurs' perceptions of public support for RE in the UK. It is the first UK study to evaluate the RE policy support framework from a micro-level perspective.

Results in this study show that the publication of the RE road map (DECC 2011b) as well as the introduction of the renewable heat incentive and feed in tariffs (DECC 2010a, Department for Energy and Climate Change 2012) are all policy initiatives that seem to have been received positively leading to improved views about the favourability of the regulatory support environment. The challenge remains to ensure consistency of these new policy incentives given that the UK has a track record of volatility in its RE policy framework as shown in table 5.2.

Table 5.2: A timeline of key policy instruments in the UK

Year	Policy initiative
1989	Deregulation and Non-Fossil Fuel Obligation (NFFO)
1997	Government encouragement for biofuels
1998	Investment subsidies
2001	Carbon tax
2002	Renewables Obligation
2002	Capital grants
2007	UK biomass strategy
2010	Feed in tariffs (FITs)
2011	Renewable heat incentive (RHI)
2011	RE road map
2011	Consultation to review the 2007 UK biomass strategy
2012	Review of the FITs
2012	UK biomass strategy

Source: Adapted from Thornley and Cooper, 2008, DECC 2010a, DECC 2010b, DECC 2011a, DECC 2011b, DECC, 2012, DECC/DFT/DEFRA, 2012).

In all these initiatives, the potential role of the agricultural sector has been acknowledged yet the level of enthusiasm amongst farmers as evidenced by the adoption rates of these new technologies has remained very low compared with other EU member states with similar aspirations (Sherrington *et al.* 2008).

There has traditionally been two approaches used to promote the development of RE in the EU. This involves the use of taxation and subsidies and/or a combination of approaches. The application of these two remains contentious especially as regards modes of delivery. The German example has for a long while opted for a system obliging utilities to buy electricity from producers of RE at a premium price and suppliers are guaranteed for a period of 20 years (Wilkinson, 2011).

This approach has been commended for providing necessary confidence for investors enabling individuals to be able to build more solid cases for obtaining finance from banks. The success of the German feed-in tariff is widely appreciated (Federal Ministry of Food Agriculture and Consumer Protection, 2009, German Federal Ministry for the Environment Nature Conservation and Nuclear Safety, 2004, Plieninger *et al.* 2009, Thornley and Cooper, 2008, Wilkinson, 2011). The English experience of grants and subsidies has been more market oriented- the idea being to support the most cost effective technologies. Very limited results have been obtained as many rounds of government grants have closed without substantial development of the RE sector (Mitchell, 2000, Perry and Rosillo-Calle, 2008).

Another construct/dimension of the regulatory institutional framework developed in this study was related to regulatory complexity for investment in RE. Chi square tests did not reveal any significant differences between adopters and non-adopters with regards to their perceptions of the regulatory complexities involved in the RE investment process. However, the mean values for adopters and non-adopters were all below the neutral point of 3.00 showing that respondents perceived the regulatory environment for RE investment as being complex. This represents a significant barrier for the development of RE in the UK. According to Bowen and de Clercq (2007) administrative barriers not only affect entrepreneurial effort but its allocation. Excessive regulations reduce entrepreneurial engagement in productive activities and may provide an incentive for entrepreneurs to devote resources to influence the regulatory environment to their benefit (Baumol, 1990). Ilbery *et al* (2009) in a study of entrepreneur's perceptions of two government grant schemes in the UK concluded that delays in appraising applications, complexities in the application processes and application costs led individuals to recruit consultants to lead the processes; draw up the business plans, liaise with the funding agency/council with no

certainty of success (Ilbery *et al.* 2009). They found that people with more experience in applying for government funds (serial adopters) were more advantaged through connections with consultants and government agents.

The development of the regulatory complexity scale in the current study and its strong internal reliability suggests that research on the effectiveness of RE policy needs to consider planning issues independently from overall government support such as tax/credit incentives, subsidies, etc. When multivariate statistical analysis was carried out to investigate the effect of the institutional dimensions on investment intentions, the results showed that the country's two regulatory institutional dimensions measured by regulatory support and complexity were not directly related to investment intentions. The finding in this research that the regulatory dimension was not directly related to intentions is similar to research findings reported by Kostova and Roth (2002), Bowen and de Clercq (2007), de Clercq *et al* (2010) and Alvarez *et al* (2011). As indicated earlier this is the first UK study to analyse the influence of the country's institutional profile on farmers' entrepreneurial intentions in the UK. In the absence of similar studies in farm entrepreneurship or entrepreneurship more generally, the following sections discuss and compare the research findings with other European and American entrepreneurship research. It is also important to indicate that the other study results are based on student samples and aggregate macro level data which might be interpreted as methodological shortcomings.

Kostova and Roth (2002) carried out a ten country study to analyse the effect of country institutional profiles on the adoption of quality management practices by subsidiaries of a US based multinational business company. Using the framework developed by Busenitz *et al* (2000) and a sample of 534 managers and 3238 non-managerial employees, the authors found that there was no significant influence of the regulatory institutional dimension and practice adoption while significant relations emerged for the effects of the cognitive and

normative institutional dimensions on quality management practice adoption by employees as is the case in this study.

Bowen and de Clercq (2007) conceptualised the institutional context as consisting of the availability of financial support for entrepreneurship, the extent of educational capital, the regulatory framework consisting of regulatory protection and complexity and the level of corruption. In measuring the effect of these factors on total entrepreneurial activity (TEA), the authors used aggregate macro level data from the Global Entrepreneurship Monitor (GEM) reports to operationalise the measures. Results from this study found that the regulatory dimension was not related to total entrepreneurial activity while financial capital and human capital and the level of country corruption were significantly related to TEA.

In another 14 country study by de Clercq *et al* (2010) to evaluate the influence of institutional burdens/constraints on TEA, it emerged that the regulatory institutional dimension was also not related to TEA. The author explained this finding by suggesting that the difficulty in the mobilisation of required resources often means that business initiatives never take off because entrepreneurs lack sufficient capital and managerial expertise to do so. De Clercq *et al*. also speculated that in more developed and liberalised economies, new businesses have to deal with competition and in some cases even viable business options never get started because of competition.

The most recent work by Alvarez *et al* (2011) revealed similar results to those presented in this research. The authors carried out an analysis of the effect of environmental conditions on entrepreneurial activity in Spain. Using GEM data, the authors found that there was no relationship between the availability of government support programmes and total entrepreneurial activity while other informal institutional dimensions were significant.

The lack of a statistical significant influence of regulations on intentions may suggest that in effect entrepreneurs with strong intentions may want to pursue their goals despite the potential administrative barriers (Bowen and de Clercq, 2007). Another reason still derived from these authors is that administrative problems may be limited to the initial decision to start a new venture but not to the type of business activity chosen. While the findings of this research resonate with those presented above, other studies have found contrasting results of the effect of regulatory dimensions on entrepreneurial activity (Baldegger, 2012, Spenser and Gómez, 2004, Meek *et al.* 2010, Prieto *et al.* 2010, Amonrat, 2010).

Spenser and Gomez (2004) analysed the effect of national level institutional factors on entrepreneurial activity. They defined entrepreneurial activity as consisting of a continuum ranging from self-employment as a basic form of entrepreneurship, the prevalence of small firms in the economy to the number of listings in a country's stock exchange as the most advanced form of entrepreneurship. Contrary to the results of this study, the regulatory institutional dimension was negatively related to rates of self-employment suggesting that countries with lower regulatory burdens actually led to lower levels of self-employment. As with this research, the authors found no relationship between the regulatory institutional dimension and the prevalence of small firms. Stenholm *et al* (2011) also found a negative but non-significant influence of the regulatory institutional dimensions on types of entrepreneurial activity.

In one of the first known studies to evaluate the effect of the country institutional profile from a micro level perspective in the Swiss, Finnish and New Zealand software sector, Baldegger (2012) also found a marginal negative significant effect of the regulatory dimension on levels of firm performance. Baldegger speculated that in a regulatory environment that supports start-up businesses competitive intensity may actually lead to poor firm level financial performance.

It appears that research to date has provided mixed results of the effect of the regulatory dimension of a country's institutional profile on the levels of entrepreneurial activity. Meek *et al* (2010) found the availability of solar incentives was significantly and positively related to higher rates of creation of solar energy enterprises in the United States of America. In a comparative study to evaluate the propensity for self-employment in student samples from the US and Mexico, Prieto *et al* (2010) found positive relationships between regulatory dimensions and entrepreneurship while Amonrat (2010) found only marginal positive effects in the second known micro level study of entrepreneurship applying the country institutional profile in Thailand. Amonrat (2010) argued that these inconsistent findings reported on the effect of the regulatory dimension on entrepreneurial activity, could be an artefact of the research approaches and measures used. He contended that because the research on entrepreneurial activity is based on aggregate macro level institutional data derived from GEM reports, OECD, ILO and World Bank databases as well as the different definitions of entrepreneurship (e.g. self-employment, prevalence of small firms, firm listings on the stock exchange, total entrepreneurial activity) it was likely that the results did not really reflect individual level entrepreneurship.

Baldegger (2012) argues that researchers need to move the analysis of institutional effects from country level only to the level of individual enterprise as has been done in this research. To clarify this issue, the TEA measure used in the Bowen and de Clercq (2007) study only captures a country's rate of new start-ups which is a national level measure. Linking this measure with perceived institutional profiles measured at individual level may not actually provide an accurate evaluation of the effect of the institutional profiles and entrepreneurial development (Amonrat, 2010). By measuring entrepreneurial intentions and perceived institutional profiles at the same level as has been done in this investigation provides a more accurate picture of the effects of institutional profiles on entrepreneurship. This is an important contribution because as has been shown already, "past research has

demonstrated that institutional factors affect entrepreneurial macro level outcomes but little is known of the mechanisms through which the effects appear" (Baldegger, 2012, p.1) and hence the approach adopted in this study provides understanding of the mechanisms involved.

The result of a "non-effect" of the regulatory dimension on intentions in this thesis can be explained at the micro level institutional/sociological perspective. Social learning theory (Bandura, 1977, 1989) as well as theories of planned behaviour used in this thesis (Azjen, 1991, Shapero and Sokol, 1982, Krueger and Brazeal, 1994, Krueger *et al*. 2000) all argue that the environment - behaviour relation is mediated by cognitive variables (desirability and self-efficacy) which determine which parts of the environment will be perceptually selected, processed and subsequently attended to in behavioural terms (Baldegger, 2012, p.2).

5.2.2.2 The influence of the cognitive institutional dimension on intentions

The cognitive institutional profile has been defined as the widely shared social knowledge and cognitive categories (for example schemata, stereotypes) used by people in a country that influences the way in which a given practice is categorised and interpreted (Kostova and Roth, 2002, p. 217). Manolova *et al* (2008) defined the cognitive institutional profile as consisting of the knowledge and skills possessed by people in a country pertaining to the creation and operation of a new business. According to the institutional perspective, this dimension can operate at the individual level and influence the ability of the entrepreneur to invest in a new venture.

To investigate the effect of the cognitive institutional environment on investment intentions, a measure of the country's cognitive environment was developed based on established works of Busenitz *et al* (2000), Kostova and Roth (2002), Manolova *et al*

(2008). Principal component analysis of the factors measuring the country's institutional factors resulted in four items measuring the cognitive environment for RE and internal reliability analysis showed a Cronbach α of 0.68 which was judged adequate (Hair *et al*. 1998, Kostova and Roth, 2002).

In order to investigate the effect of respondent's perceptions of the favourability of the cognitive environment on intentions, preliminary pairwise correlations showed that there was a statistical significant positive correlation between the cognitive environment measure and intentions ($r=0.17$, $p<.0.001$). Results presented in section 4.4.2 chapter 4 showed that when respondents were asked to report their perceptions about the supportiveness of the cognitive environment, that no statistical significant differences between adopters and non-adopters of RE ventures were observed. Further analysis showed that respondents viewed the cognitive environment for RE as being unfavourable to drive investments in the sector.

According to Connor (2003), lack of familiarity with the different RE support mechanisms and increased perception of risk is likely to make it more difficult for investors to engage in the sector. Spenser and Gomez (2004) contended that the lack of skills to identify relevant information and manage business risks was characteristic of non-entrepreneurial climates. Past research has shown that the lack of basic information about markets for products, sources of finance, how to set up and run business inhibits entrepreneurial activity (Businetz *et al.* 2000, Descotes *et al.* 2007, Manolova and Yan, 2002, Manolova *et al.* 2008).

Evidence presented in section 4.2.6.2 chapter 4 showed that there were three important cognitive/knowledge related barriers to investment in RE ventures: the most important being lack of trust in government policy followed by the lack of awareness of information

about government grants and lastly the lack of knowledge and skills required to set up and manage RE ventures. Past research reports show that mistrust in government policies also limits entrepreneurial activity (Descotes *et al.* 2007, Dadashev *et al.* 2003). The barriers identified in this thesis (chapter 4.2.6.2) are largely in line with past research reports on the barriers to RE development (Rosch and Kaltschmitt, 1999, Foxon *et al*. 2005, McCormick and Kaberger, 2007, Adams *et al.* 2011) but superior in that the findings of this study are grounded on established theory.

Domac *et al* (2005a) argued that a common constraint for RE development in the EU is inadequate information and awareness among stakeholders in the economy and politics. One major challenge for the agricultural sector is to enable farmers to have access to information and develop entrepreneurial skills in order to enhance farm survival by exploiting opportunities created by the changing farm context (Vesala *et al.* 2007, Vesala and Pysysiainen, 2008). What is more problematic is that farmers often find it difficult to be entrepreneurial (Tate, 2010) as they often lack the requisite knowledge, skills and networks to build viable businesses (Grande, 2011, McElwee, 2006, McElwee, 2008a).

As mentioned in chapter 2, there are many organisations providing advisory, extension and skills development services to farmers on RE issues in the UK. The most prominent are government departments, non-department public bodies and quasi autonomous government agencies (Slade *et al.* 2009, Taylor, 2008). These education and training systems are components of the cognitive institutional environment which encourage individuals to be more entrepreneurial as they provide key skills and information needed to start up initiatives (Jensen *et al.* 2007, Jenssen and Havnes, 2002). As the results of this research have shown, the existence of these systems is no panacea for entrepreneurial activity as it has been shown that mismatches often abound between what is required by beneficiaries and what is effectively offered by external agencies (Normann and Klofsten, 2009). For

this reason, Sherrington *et al* (2008) argued that farmers need trusted, clearly independent, practical and specific information at an individual farm level to help them make investment decisions and take on new ventures. Research must provide understanding of the information and skill needs of entrepreneurs. It is desirable that information is tailored and made available through sources that are most appropriate and accessible to those in need (Sherrington *et al.* 2008).

While the evidence presented in this report shows that respondents perceived the cognitive environment to be unfavourable for RE development, multiple regression analysis actually revealed that perceptions of the cognitive environment had a statistically significant influence on RE investment intentions ($\beta = 0.13$, $p<0.01$). This is an interesting contribution of this study given that previous research to evaluate the factors affecting the participation of farmers in environmental schemes did not reveal any significant relationships between the farmers' information environment and rates of participation (Wilson 1996) which was mainly the results of a very "loose methodology" adopted (Burton 2004). The cognitive environment measure developed in this study provides a basis to improve research methodology in such studies as the one undertaken by Wilson (1996).

The result of a positive relationship between perceptions of the cognitive environment and intentions in this study is in line with those reported by Spenser (1996); Spenser and Gomez (2004) who also reported a positive relationship between this institutional dimension and rates of new firm creation. Similarly, Amonrat (2010) reported a marginally significant positive effect on entrepreneurial intentions in Thailand. Although entrepreneurial intentions are not the same as entrepreneurial activity, they have the closest implication. Positive relations between access to educational/entrepreneurship programmes

and entrepreneurship have also been reported in past entrepreneurship research (Zhao *et al.* 2005, Kuehn, 2008, Bowen and De Clercq, 2007).

Contrary to the results of this study, de Clercq *et al* (2010) and Alvarez *et al* (2011) found that dimensions of the cognitive environment were rather negatively related to entrepreneurial activity while Baldegger (2012), Stenholm *et al* (2011) and Lim *et al* (2010) did not find any significant relationships. De Clercq *et al* (2010) posited that in countries with high cognitive burdens aspiring entrepreneurs may not have the skills and knowledge about how to start a new business activity, they may lack the skills that allow them to network and mobilise requisite resources for venture creation.

The finding that the cognitive environment was positively related to intentions in this research is very useful in the sense that cognitive dimensions of a country's institutional profile are amenable to education and training (Spenser and Gomez, 2004). Institutional theory suggests that shared knowledge about a practice in public contributes positively towards its adoption (Scott, 1995, 2008). According to Kostova and Roth (2002), what is important for the adoption of a practice is having social knowledge about the practice, which helps people understand the practice correctly, and having a set of societal values and beliefs that are consistent with the practice. Institutional theorists also strongly argue that although the normative business environment may encourage people to be entrepreneurial, it is the cognitive and regulatory environments which provide the skills and support necessary for firms to be successful (Busenitz *et al.* 2000, Bowen and de Clercq, 2007).

This suggests that in an era characterized by recession and scarce financial resources, attention needs to be placed on improving the cognitive environment rather than focusing on the provision of grants and subsidies for RE development. For example, policy makers

need to improve the cognitive environment by providing requisite knowledge and skills for farmers through training programmes, workshops and seminars. Other support needs to be provided to private sector organisations to ensure that coherent and consistent information about RE is disseminated throughout society. Capacity building theory suggests that human capital of entrepreneurs can be enhanced leading to improved abilities to perceive and exploit opportunities (Meccheri and Pelloni, 2006). Such an approach might lead to the development of more economically and environmentally sustainable enterprises than current subsidy dependent agricultural systems (Munday *et al*. 2010).

5.2.2.3 The influence of the normative institutional dimension on intentions

The **normative** pillar of the administrative theory of entrepreneurship refers to the degree to which residents of a country admire entrepreneurial activity and appreciate creative and innovative thinking (Kostova, 1997). The normative institutions also exert influence because of the social obligation to comply, rooted in social necessity in what an organisation should be doing. They are typically made up of values (what is preferred) and norms (how things are to be done in line with the values (Bruton *et al.* 2010). Otherwise stated normative dimensions of a country's institutional profile define what is appropriate and right for society's members (Trevino *et al.* 2008).

This study has constructed variables to measure a country's normative environment from the works of Busenitz *et al* (2000) and Prieto *et al* (2010). Principal component analysis of the items designed to measure the country's normative institutional environment yielded two factors relating to general social acceptance of entrepreneurship and norms of support of family, friends and social networks. The internal reliability analysis revealed that the measures developed were valid and internally consistent. These dimensions were considered valuable measures of the normative environment following similar frameworks

used by institutional theorists including Baughn *et al* (2006a, b), Alvarez *et al* (2011) and de Clercq *et al* (2010).

It was hypothesized that there would be a positive association between society's acceptability of entrepreneurship and intentions. This hypothesis was supported and contrary to expectation the relationship was found to be negative (β= -0.12, $p<0.05$) suggesting that a one standard deviation change in society's admiration for entrepreneurship, would rather lead to a 12% decline in intentions. Pairwise correlations showed a negative significant relationship between social acceptability of entrepreneurship and investment intentions. Past studies have shown that the degree to which society views entrepreneurship negatively or positively affects entrepreneurial activity (Busenitz *et al.* 2000, Baughn *et al.* 2006a, b, Amonrat, 2010, Prieto *et al.* 2010, Stenholm *et al.* 2011).

The result that society's acceptability of entrepreneurship in the UK had a negative influence on intentions was counter intuitive given the fact that the mean score evaluation for this construct showed that respondents viewed the normative environment as being more favourable than the regulatory and cognitive institutional environments. However, the results are supportive of those results obtained by Kostova and Roth (2002) in their study of adoption of quality management practices in organisations. The results are also consistent with those reported by de Clercq *et al* (2010), Alvarez *et al* (2011) and Stenholm *et al* (2011) but different from those reported by Spenser and Gomez (2004), Linan and Chen (2009) and Krueger *et al* (2000) where no relationship between social norms and entrepreneurship were observed.

The finding that society's admiration for entrepreneurship was negatively related to intentions necessitates further research. A possible explanation for this unexpected result may be found in the fact that farmers often value independence. Burton and Wilson (2006)

argued that because of this value, farmers may be unwilling to suggest in a questionnaire that they are under the social influence of others. In the study of the effect of formal and informal institutions on entrepreneurial activity, Alvarez *et al* (2011) found similar results to this study and argued that the unexpected result could be because experts have an ideal of entrepreneurs based on some values and attitudes, but those values may not be determinants of entrepreneurship. Another possible reason for this result is that even though society may view RE favourably, very few would actually support or admire entrepreneurs setting up such enterprises in their backyards (Adams *et al*. 2010). Stenholm *et al* (2011, p. 14) found a negative relationship between the normative institutional dimension and type of entrepreneurial activity. The authors suggested that in some cases "even if entrepreneurship is a socially acceptable choice, pursuing growth and innovative-oriented new venture is not". This argument fits perfectly with extant literature on social acceptability of RE (Wüstenhagen *et al.* 2007). For this study therefore, it is likely that there may be more normative disapproval of farmers starting RE enterprises than has been previously thought. There is also differential opposition to RE as some enterprises are viewed more negatively (onshore wind, energy crops) than others (e.g. offshore wind, solar, and hydro) (Munday *et al.* 2010) and the relationship between society's acceptance of entrepreneurship in the RE sector might not be linear.

McCormick and Kaberger (2007) proposed that improved understanding of RE energy systems by the public was important to generate needed support. They proposed that this can be achieved through local initiatives on climate change and environmental protection to build local involvement. Another key strategy may be for policy makers to make use of local champions or early adopters as promoters of these technologies. This may be a more cost effective approach to encouraging other farmers and local communities to develop positive attitudes towards the enterprises. Jacobsson and Johnson (2000) also proposed that prime movers play four key roles that may facilitate social acceptance of entrepreneurship:

they raise awareness, create legitimacy, invest in the enterprises and diffuse the technologies. Such initiatives may increase legitimacy of new business attempts and thus reducing social acceptability barriers (Prieto *et al.* 2010).

This research also investigated the influence of the second dimension of the normative institutional profile – perceived support of family, friends and business networks and entrepreneurial intentions. Modelling results showed that support of social relationships was positively associated to intentions ($\beta = 0.12$, $p<0.01$) providing support for the hypothesized relationship. Past research has shown that even if a farmer holds a positive view of an attitude, pressures from significant others will also influence the final decision to carry out a behaviour or not (Burton, 2004). Not all past research agrees with this. Mattison and Norris (2007) did not find any significant relationships between farmers' perceived support of referents and intentions to grow energy crops in the UK. Similar conclusions to this were reached by Wilson (1996), Battershill and Gilg (1997) and Falconer (2000) in their studies of the factors affecting farmers' participation in environmental schemes. Burton (2004) suggested that this was possibly the result of "loose methodologies" applied in these studies. Burton argued that the use of inadequate sampling procedures, lack of theoretical basis for the definition of measures and poor statistical approaches contributed to the non-find. For example Battershill and Gilg (1997) defined the normative environment as consisting of the information environment (the contribution of advisory services, other farmers…) without any theoretical foundation.

On the second dimension of the country's normative environment, this research found a positive relationship between support of family, friends and associational networks and intentions. This is in accord with recent research findings that family networks as well as associational activity play an important normative support role in entrepreneurship (Baughn *et al.* 2006a, Baughn *et al*. 2006b, Prieto *et al.* 2010, de Clercq *et al*. 2010).

Networks of friends and family play a role in facilitating access to resources and skills needed to build the confidence of an individual to take advantage of business opportunities (Morgan *et al*. 2010, Sequeira *et al.* 2007, Linan and Santos, 2007). Past environmental entrepreneurship research has also shown that norms of family support contribute to higher levels of entrepreneurship in the US solar energy sector (Meek *et al.* 2010). Baughn *et al* (2006b) even argued that the impact of close friends and family may be even more critical than general normative support in shaping individual perceptions towards new venture creation.

The existence of a positive relationship as evidenced in this thesis provides support for the inclusion of this variable in studies of farmers' RE investment intentions. By not considering this factor as relevant e.g. Willock *et al* (1999, Tranter *et al* (2011), researchers basically take out the farmer from his/her social context (Burton, 2004). To ignore this factor is counter intuitive especially when research is focused on decisions that may have long term effects on the farm and the farm household. Investments in RE tend to be long term in nature and as such long term market contracts and succession issues are bound to affect investment decisions. Where family support is available, decisions to invest in RE can be made easier. Farmers make use of the skills of the different family members in different ways; filling grant application forms, creating networks, market negotiation etc. (Sherrington *et al.* 2008).

5.2.2.4 The co-dependencies between normative and regulatory institutions

Hypothesis 3 developed in this study was proposed to investigate the possibility of interaction effects between different dimensions of the country's institutional profile and entrepreneurship posited by earlier institutional theorists (Spenser and Gómez, 2004, Meek *et al*. 2010, Dacin *et al.* 2002). Results in this study demonstrate empirically that normative institutions play a significant supplemental role in influencing the effect of regulatory

institutions on entrepreneurship (β= 0.17, p= 0.003). From the interaction graph (figure 4.13 chapter 4) it emerged that intentions would decrease with decreasing social acceptability of entrepreneurship even with high levels of government support for entrepreneurship. Intentions were also positive with higher levels of social acceptability and government and local council support.

Society has perceived anxiety about the adverse impacts of some RE enterprises. On the other hand the public is increasingly distrustful of government policymakers as RE is seen more as an imposed top-top option. Many in society observe that the development RE is a good thing but should not conflict with local policies. The moment development poses a threat on the values and expectations of people, mistrust ensues most especially when the benefits of the proposed developed are unclear to the local people (Upreti and van der Horst, 2004).

This research shows that informal institutions have a larger influence on entrepreneurship than formal institutions (Alvarez *et al.* 2001). Given the strong influence of normative institutional factors found in this study, small business and entrepreneurship researchers need to integrate these measures in studies of the influence of contextual factors on entrepreneurship alongside national level formal institutional factors. The existence of a moderation effect suggests that government's task should be geared towards improving social acceptability of entrepreneurship in the UK farm sector. This means that while formal regulatory have some effect on improving attitudes towards entrepreneurship, socially enforced beliefs may lead to maximising the impact of policy seeking to encourage entrepreneurship of the adoption of environmentally beneficial practices as evidenced in the solar energy sector in the United States (Meek *et al*. 2010). The existence of a moderation effect in this study suggests that future studies on the determinants of entrepreneurial activity should not only examine the formal regulatory factors or concentrate on broad cultural factors (Hayton *et al.* 2002, George and Zahra, 2002, Mueller

and Thomas, 2001) affecting entrepreneurial activity but should also include the wider social institutions which also facilitate entrepreneurs' efforts to discover and exploit opportunities that are created by relevant market failures (Dean and McMullen, 2007).

5.2.3 Influence of perceived self-efficacy and desirability on intentions

To investigate the effect of cognitive factors on investment intentions, two constructs were developed from Shapero and Sokol (1982) SEE model, Krueger and Brazeal (1994) entrepreneurial intentions model, the theory of planned behaviour (Azjen, 1991) and Bandura's social cognition theory (Bandura, 1986,1997,1999) namely perceived self-efficacy and perceived desirability.

Self-efficacy determines both the strength of entrepreneurial intentions and the likelihood that those intentions will result in entrepreneurial actions (Boyd and Vozikis, 1994). Self-efficacy, commitment and confidence distinguish those who engage in, and persist in actions from those who do not (Trevelyan, 2009). That is individuals are more inclined to engage in entrepreneurial activities when they believe they have the necessary skills required to operate in that environment (DeNoble *et al.* 1999). It was therefore hypothesised that current adopters of RE ventures or those with positive intentions towards RE would have higher perceptions of self-efficacy.

Shapero and Sokol defined perceived desirability of a venture as the degree to which one found the prospect of starting a new business attractive (Shapero and Sokol, 1982). Krueger and Brazeal (1994) suggested that Shapero and Sokol's perceived desirability construct subsumed two attractiveness components of the Theory of Planned Behaviour: attitudes toward an act and social norms. According to Azjen (1991) attitudes towards an act refer to the extent to which an individual found the prospect of an act personally desirable and in turn was influenced by the likely personal impacts of the outcomes from

performing the behaviour. Social norms referred to an individual's perceptions of what important people thought about a possible new venture and the motivations to comply with the expectations of the referents. For this reason, it was also hypothesised that current adopters were likely to perceive RE as more personally desirable than current non-adopters and that individuals with higher perceptions of desirability would be more likely to develop positive intentions towards RE enterprises.

In developing the perceived self-efficacy construct, items were derived from Chen *et al* (1998), de Noble *et al* (1999), McGee *et al* (2009) to capture individual perceptions regarding their abilities to carry out specific tasks involved in the process of setting up an RE venture – identification of market opportunities, selecting appropriate RE ventures for the farm business, marshalling resources, planning and management of the business. Items used to develop the perceived desirability construct were developed based on the works of Shepherd and DeTienne (2005), Mitchell and Shepherd (2010). Perceptions of desirability are sets of subjective expectations of what entrepreneurs think can be accomplished (Edelman and Yli-Renko, 2010). These may refer to the value to be gained from investing in specific activities. This value added can be economic returns and or social contribution to the entrepreneur's efforts (Mitchell *et al.* 2010). Four items were developed to capture the potential contribution of RE to economic and non-economic goals, the availability of markets for RE products and the opportunity cost of the RE enterprise compared to traditional or existing farm enterprises. It is important to highlight the fact that most of the studies looking at perceived desirability tend to use student samples (Krueger, 1993, Krueger *et al.* 2000, Kolvereid, 1996, Autio *et al.* 2001) and perceptions of the students are often stated as consisting of a choice between self-employment as entrepreneurship and being employed. This is because entrepreneurship research has primarily been concerned with the start-up of new firms and it is only very recently that entrepreneurship has become accepted as a firm level phenomenon deserving scholarly attention (Carrier, 1996,

Amonrat, 2010, Baldegger, 2012). This study contributes to fill this gap by considering entrepreneurship as a firm level process.

10 items were developed to measure perceived self-efficacy and desirability of RE in this study. Results of factor analysis and internal reliability analysis showed that the constructs developed were uni-dimensional and had very good internal reliabilities (Brace *et al.* 2009, Hair *et al.* 1998). To investigate whether adopters/potential adopters were different from non-adopters in terms of their entrepreneurial cognitions as hypothesised, independent t-tests were applied given that the measures developed to capture the constructs of perceived self-efficacy and perceived desirability were considered to be scale variables (Bryman and Cramer, 2009, Brace *et al.* 2009).

It emerged as expected that adopters were more confident in their abilities to identify opportunities, identify the right type of technology, assess financial viability of the enterprises, mobilise resources, lead planning processes and manage and coordinate farm financial reports than non-adopters. In support of the results presented in part 3, chapter 4, perceived feasibility was conditioned by a number of other factors. Farmers with higher educational attainments, with larger farm sizes and agricultural business turnovers and those operating family partnerships and limited companies reported higher levels of self-efficacy than those limited resources. These results provide support to research carried out by Alsos *et al* (2003), Carter (1998) and Vesala *et al* (2007). Alsos *et al* (2003) argued that resource exploiting and pluriactive farmers were more likely to have larger farm business, ownership was likely to be family based, had unique resources and tended to register new enterprises as separate businesses. Similarly Carter (1998) showed that portfolio owners were most likely to operate limited companies, operate large farm businesses in excess of 500 ha with higher sales revenues than monoactive producers. As for Vesala *et al* (2007), they found out that self-efficacy was a consistent differentiating factor between portfolio

and non-farm entrepreneurs, portfolio and conventional farmers as well as nonfarm entrepreneurs and conventional farmers.

This research also found that adopters were more likely to show higher perceived desirability of RE ventures than non-adopters. This result confirmed other findings of this study which showed that 52% of current adopters said farm business performance had improved slightly or significantly with financial contributions estimated at up to £25,000 to business turnover. Adopters were more likely to view RE as personally desirable. To provide further support for the stated hypothesis, when current non-adopters were categorised into potential adopters and non-adopters groups (see section 4.6), there was a significant difference between potential and non-potential adopters. Potential adopters appeared more confident (mean 3.56) in their abilities to identify market opportunities, mobilise necessary resources and set up RE enterprises more than non-adopters (mean 2.95). Similarly potential adopters were more likely to perceived that investing in RE was personally desirable well above the levels of desirability observed amongst non-adopters adopters.

These results have shown that individual cognitions play a very important role and distinguish those who invest/intend to invest from those who do not invest/intend to invest in RE. These findings are very much in line with the arguments outlined by social cognition theorists (Bandura, 1986, 1977, 1999; Gist and Mitchell, 1992, Boyd and Vozikis, 1994, Chen *et al.* 1998). As suggested in the model in 2.8.4 chapter 2, the farmers' capacities and the farm business resources influence perceptions of feasibility and attractiveness of RE ventures. After assessing the differences between adopters/potential adopters and non-adopters with regards to their perceptions of self-efficacy and desirability using basic independent t-tests, multivariate data analysis was carried out to evaluate the influence of these cognitive variables on entrepreneurial intentions as posited by Shapero

and Sokol (1982), Azjen (1991), Krueger (1993), Krueger *et al* (2000), Fitzsimmons and Douglas (2010) and Townsend *et al* (2010). Two hypotheses were stated in section 2.8.5 as shown in table 5.3 below. H4 was developed to test the direct effect of perceive self-efficacy and perceived desirability on intentions while H5 was designed to evaluate the possibility of joint effects between the cognitive variables. Shapero and Sokol (1982) argue that these perceptions are considered sequentially rather than simultaneously and so the joint effect hypothesis was developed to confirm this view considering arguments to the contrary by Krueger (1993) and Fitzsimmons and Douglas (2010).

Results showed that attitudes towards entrepreneurship have a significant positive influence on farmers' investment intentions (table 5.3). Perceived self-efficacy of RE ventures was strongly and positively related to farmers' investment intentions (β=0.28, p= 0.000). Similarly, perceived desirability of RE was strongly related to investment intentions (β=0.44, p= 0.000).

Table 5.3: Summary of results: the influence of perceived self-efficacy and desirability on intentions

Hypotheses	Expected sign	Relationship
H4: Perceived self-efficacy and desirability of RE ventures	+	
• Perceived self-efficacy of RE ventures	+	Positive***
• Perceived desirability of RE ventures	+	Positive***
H5: perceived desirability X perceived self-efficacy	+	No relationship -

*Level of significance: *p < 0.05, ** p< 0.01, ***p< 0.001*

The results of the effects of individual cognitions on entrepreneurial intentions in this research further endorse research applying intentions models (Azjen, 1991, Krueger and Brazeal, 1994, Krueger, 1993, Krueger *et al.* 2000, Liñán and Santos, 2007, Liñán and

Chen, 2009, Fitzsimmons and Douglas, 2010, Lee *et al.* 2010). The results obtained suggest that respondents who perceived RE ventures as being personally desirable were more likely to form positive intentions than those who did not consider RE as being an attractive investment option. It also show that individuals who reported higher levels of SE were more likely to form positive intentions than those with lower levels of SE. Chen *et al* (1998) and Mitchell and Shepherd (2010) argue that people with higher SE were more likely to associate challenging situations with rewards such as profit, community recognition and psychological fulfilment. They contend that even if people perceive risks, those with higher SE were more likely to view such situations as replete with opportunities. The findings in this thesis mean that farmers who are confident in their abilities are more likely to be interested in investing in RE despite the current volatile RE policy and market conditions.

Perceived desirability emerged as having the most important influence on intentions compared to perceived feasibility. Investment in RE was therefore concluded to be entrepreneurial and driven by perceptions of opportunity (Stevenson *et al*. 1985, Clark, 2009). Shane (2000) defines entrepreneurship as the pursuit of opportunities despite available resources. Azjen (1991) argues that the more an individual's attitude towards an act was favourable, the more likely was the probability of the intent to perform the behaviour. Similarly, Krueger (1993) and Shapero (1982) suggest that intentional behaviour typically involved identifying goals before identifying means to achieve them.

The higher levels of influence observed in this study for perceived desirability on intentions is in line with many studies of planned behaviour (e.g. Fitzsimmons and Douglas, 2010, Linan and Chen, 2009, Linan, 2008, Krueger, 1993). There are also contrasting views in extant literature. In a study of the influence of perceived outcomes and perceived abilities to start a new venture, Townsend *et al* (2010) found only a marginal

effect of opportunity perceptions on the venture creation decision while ability expectancies had a significant influence suggesting perceived outcomes played a very small role driving venture creation processes as opposed to ability expectancies. Kolveried (1997) and Autio *et al* (2001) used the theory of planned behaviour constructs (attitudes, social norms (SN) and perceived behavioural control (PBC) to predict self-employment intentions amongst students from Scandinavia and the United States. They found that PBC had the most important influence on intentions followed by subjective norms and finally attitudes towards self-employment. Similar results were also reported in a study of Russian students by Tkachev and Kolveried (1999). An earlier study by Kolveried and Isaksen (1996) found significant relationships between attitudes and SN and self-employment intentions but not with PBC which in their opinion was the result of poor operationalisation of the variables.

There are two known studies that have applied the TPB to evaluate farmers' intentions to invest in RE. In the first study, Mattison and Norris (2007) found that perceived behavioural control and subjective norms were not significantly related to intentions to grow biofuel oilseed rape. The results of this research are in agreement with those obtained by Sherrington and Moran (2007) who found stronger correlations between stated attitudes towards energy crop production than those observed for PBC and intentions. The results in this study are superior in that they go beyond simple correlation analysis and provide understanding of the degree to which attitudes actually influence intentions.

One of the objectives of this study was to examine the possibility of interaction effects between perceived self-efficacy and perceived desirability. Krueger (1993), Townsend *et al* (2010) and Fitzsimmons and Douglas (2010) argue that perceptions of self-efficacy and desirability were formed simultaneously while Shapero and Sokol (1982) contend that these perceptions were formed sequentially as assumed in this thesis. The results obtained

are supportive of Shapero and Sokol's conceptualisation and in line with empirical findings by Townsend *et al* (2010), Krueger (1993) but different from those obtained by Fitzsimmons and Douglas (2010) who found a significant negative interaction effect of perceived feasibility and desirability on investment intentions. Though the joint effects model in the current study is not statistically significant, the regression analysis shows that the β for the interaction term was negative (β= -0.02, p= 0.692) which was identical to the results reported by Fitzsimmons and Douglas (2010). These authors argue that the existence of a statistical significant negative coefficient for the interaction terms shows that the intention to act entrepreneurially could still form with different combinations of higher or lower levels of self efficacy and perceived desirability. In effect Bandura (1977) makes it clear that ability and outcome expectancies are separate constructs when he argues that even if an individual perceives the outcomes of behaviour to be favourable, such information is unlikely to influence the behaviour if they entertain doubts about their abilities to carry out the required activities.

In line with the arguments put forward by Krueger *et al* (2000), results of this research show that taken individually, personal level/organisational characteristics as well as situational variables (institutions) explain only a small share of the variance in RE investment intentions. By taking into consideration the key dimensions of the entrepreneurial process in this study (individual, business, situational and inter-personal) this research achieved comparable and even superior explanatory power to past entrepreneurial intentions studies. For example, in a study to investigate the predictive power of the TPB and the SEE, Krueger *et al* (2000) found that the variables (past experience, perceived feasibility and desirability) explained 40% of the variance in student self-employment intentions.

5.2.4 Mediation effects of perceived self-efficacy and desirability of RE ventures

Two hypotheses were stated to evaluate the mediating effects of perceived self-efficacy and desirability of RE ventures in this research in line with established Social Cognition Theory, Planned Behaviour/intentions based research (Bandura, 1977, 1989, Shapero and Sokol, 1982, Krueger, 1993, Krueger *et al.* 2000).

The mediation effects were analysed following the widely used method proposed by Kenny and Baron (1986). According to these authors, for a mediation effect to exist, a number of conditions have to be met: (i) the independent variable should be directly related to the dependent variable, (ii) the mediating variable must affect the dependent variable, (iii) the independent variable must affect the mediator and when the independent and mediator variables are regressed against the dependent variable, the resulting effect of the independent variable on the dependent variable most be equal or lower that the result obtained in first step.

The direct effects of independent variables (farm based resources, institutional and cognitive variables) on intentions were discussed in sections 5.1.3-5.1.4. The results discussed in these sections correspond to the first and second steps in the Kenny and Baron (1986) procedure for establishing mediating effects. The third step in the Kenny and Baron (1986) procedure required that the farm based variables and institutional variables be regressed against the mediating variables. Path analysis results of this third stage revealed a number of interesting results. Firstly, perceived self-efficacy was influenced by the degree of farm business diversification, the respondent's level of education as well as the farm business turnover. Additionally, four dimensions of the country's institutional profile were shown to influence perceptions of self-efficacy; the regulatory support institutions,

cognitive institutions as well as the two dimensions of the country's normative environment.

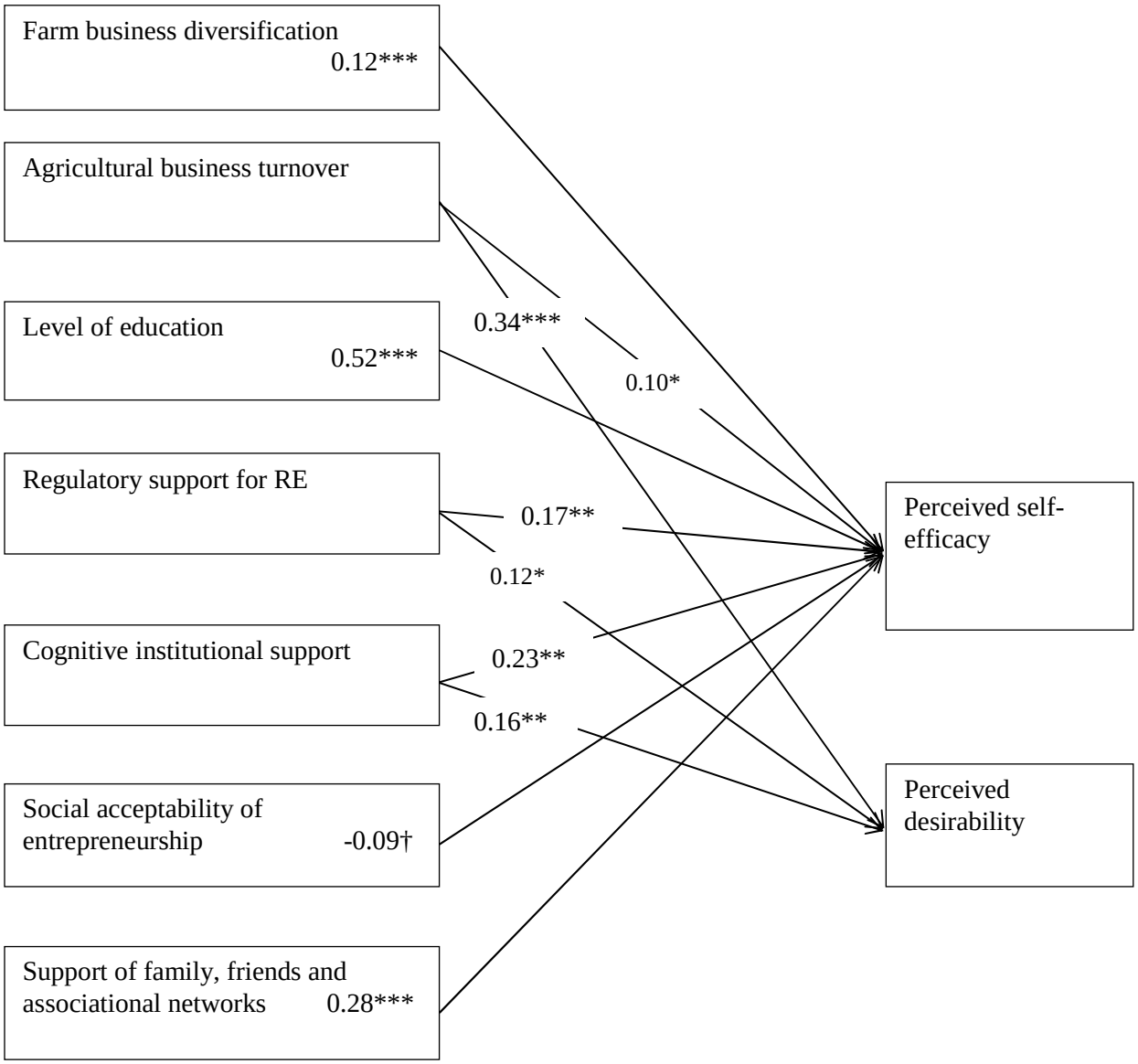


Figure 5.2: Summary of exogenous variable effects on perceptions of entrepreneurship on perceptions of entrepreneurship
Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Secondly, this thesis also found that perceived desirability of RE ventures was influenced by the farm business turnover, regulatory support and cognitive institutional environments. The last stage in the Kenny and Baron (1986) procedure to establish mediation was effected by regressing the independent variables and the mediating variables together in order to evaluate changes in the sizes of the direct effects (from stage 1) on the dependent

variable. According to Kenny and Baron (1986), a full mediation effect emerges if the β for the direct effect stage 1 becomes statistically insignificant in the third stage. Additionally, the β in stage 3 should be lower than that obtained in stage 1 for there to be a mediation effect (β stage 3<β stage 1). A partial mediation effect emerges if β stage 3 ≤ β stage 1 but the regression coefficient in stage 3 remains statistically significant or marginally significant. At this point a number of important contributions were identified as summarised in table 5.4.

Table 5.4: Summary of established mediation effect of perceived self-efficacy

Variable	β stage 1	β stage 3	Mediation
Dummies accommodation	0.12*	0.09†	Partial
Dummies agricultural contracting	0.17**	0.15**	Partial
Dum_whoten	-0.16**	-0.15*	Partial
Dum_50	-0.31***	-0.23**	Partial
Dum_belowsec	-0.22**	-0.14*	Partial
Dum_sec	-0.37***	-0.22†	Partial
Dum_uni	-0.21†	-0.11	Full
Cognitive institutions	0.13*	0.04	Full
Society's admiration for entrepreneurship	-0.12*	-0.09	Full
Support of friends, family and associational networks	0.13*	0.04	Full

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

As table 5.4 shows, most of the cases observed are situations of partial mediation. An analysis of the mediation effect of desirability perceptions was also carried out by regressing all the independent variables and the mediating variable against the dependent variable (intentions). Cases of full and partial mediation were observed. According to Kenny and Baron (1986) mediation serves to strengthen relationships between variables suggesting therefore that the two mediators proposed in this thesis can actually add value to the development of RE investment intentions.

Table 5.5: Established mediation effect of perceived desirability of RE ventures

Variable	β stage 1	β stage 3	Mediation
Dummies accommodation	0.12*	0.12*	No mediation
Dummies agricultural contracting	0.17**	0.17**	No mediation
Dum_whoten	-0.16**	-0.17**	Partial
Dum_50	-0.31***	-0.16*	Partial
Dum_belowsec	-0.22**	-0.16*	Partial
Dum_sec	-0.37***	-0.24*	Partial
Dum_uni	-0.21†	-0.08	Full
Cognitive institutions	0.13*	0.03	Full
Social acceptability of entrepreneurship	-0.12*	-0.13*	Partial
Support of friends, family and associational networks	0.13*	0.10†	Partial

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

Past entrepreneurship research shows that perceived self-efficacy and desirability of entrepreneurship mediate the relationship between the influences of external/exogenous factors on intentions (Krueger and Brazeal, 1994, Krueger, 1993, Krueger and Dickson, 1994, Krueger *et al.* 2000, Azjen, 1991) as confirmed in this investigation. According to Bandura (1977, 1999), people use four sources of information to judge their levels of self-efficacy - enactive, vicarious, exhortative and emotive sources. The impact of the information on efficacy expectations depends on how it is cognitively appraised and the situational, contextual and social contexts which events occur enter into these appraisals. Bandura argued that self-efficacy was developed through internal and external informational cues. In this study, the internal cues were measured by asking respondents to rate the abilities and knowledge with regards to specific tasks involved in the process of setting up RE ventures. The external cues related to the availability of resources derived from the farm business situation and the institutional context.

The added value of this study is the use of a rich set of external variables to evaluate their influence on perceptions of feasibility (measured by self-efficacy). This study finds that perceptions of self-efficacy and desirability are influenced by the degree of farm business diversification, the respondent's level of education as well as the farm business turnover. Additionally the country's institutional profile influences self-efficacy through the regulatory support institutions, cognitive institutions, social acceptability of entrepreneurship as well as support of family friends and associational networks. By using a large set of external variables, this study is superior to others given that past empirical research has often been criticised for using very limited sets of factors to explain entrepreneurial phenomena but for the limited exception of a few including Begley *et al* (2005) and Alvarez *et al* (2011). For example research using previous entrepreneurial experience (Krueger 1993, Kuehn, 2008, Shepherd and DeTienne, 2005), wider community support (Krueger and Brazeal, 1994), entrepreneurship education (Souitaris *et al.* 2007, Clark *et al.* 1984), gender, family background, role models, social capital (Veciana *et al.* 2005, Liñán and Santos, 2007, Hindle *et al.* 2009), skills (Liñán, 2008, Morgan *et al.* 2010, McElwee, 2006, McElwee, 2008b, McElwee and Annibal, 2010, McElwee, 2005), normative context (Baughn *et al.* 2006a, Baughn *et al.* 2006b), financial system and capital (Van Praag and Van Ophem, 1995, Lim *et al.* 2010, Shepherd and DeTienne, 2005). Such individual studies provide very limited insight into the complex factors which actually affect venture creation.

The finding that farmers' capacities and the farm business resource base influence perceptions of self-efficacy and desirability is an important contribution to knowledge. The level of educational attainment of the farmer, the levels of agricultural business turnovers, land tenancy status and the degree of farm business diversification emerges as the most significant structural determinants of self-efficacy and desirability. A finding of note is that these factors do not affect attitudes equally. For example, the farmers' educational

attainment and the degree of farm business diversification influence perceived self-efficacy but not perceived desirability while the levels of farm business turnovers have a strong positive influence on the two attitudinal variables. These findings are similar to those reported by Clancy *et al* (2011), Alsos *et al* (2003) and Carter (1998). The main difference for example when compared to Carter and Alsos and others, is that when farmers are faced with the decision to diversify or start a new enterprise, that it is their perceptions of the available resources and opportunities that brings them to carry out the behaviour and not some objective measure about the possible outcomes of their actions.

With regards to the effect of the country's institutional profile on perceptual cognitions, initial findings showed that regulatory institutional support has a higher effect on perceived self-efficacy than perceived desirability ($|\beta=0.17, p<0.01|$ > $|\beta=0.12, p<0.05|$). This result is interesting first of all because in the direct effects model presented in chapter 4, none of the regulatory institutional dimensions showed any direct effects on intentions. Secondly, the results emphasise the importance of perceptual cognitions as they serve as conduits for the effect of external factors on investment behaviour (Masini and Menichetti, 2012) and thirdly the result provides empirical support for research propositions made by Gnyawali and Fogel (1994) and Guerrero *et al* (2008).

Given the result of a positive influence of regulatory institutions on attitudes in this study, it would be expected that a more favourable regulatory framework would lead to higher levels of investment in RE through the development of positive attitudes towards RE. For example, a stable RE government policy framework (Slade *et al.* 2009, Thornley and Cooper, 2008, DECC 2011b, Plieninger, 2006, Plieninger *et al.* 2009), availability of financial incentives (Meek *et al.* 2010, Foxon *et al.* 2005, Mola-Yudego and Pelkonen, 2008, Tharakan *et al.* 2005, Wilkinson, 2011), access to bank loans and credit facilities (Tranter *et al.* 2011, The Cooperative Bank Plc, 2010), minimal administrative bottlenecks

(De Clercq *et al.* 2010, Sherrington *et al.* 2008, Dadashev *et al.* 2003) as well as state sponsorship of support organisations (Busenitz *et al.* 2000, Manolova *et al.* 2008, Jenssen and Havnes, 2002).

This research finds that the cognitive institutional environment has a strong positive influence on perceptions of self-efficacy and desirability. The effect of the cognitive environment on attitudes is unequal in that a higher effect is observed on perceptions of self-efficacy than on perceptions of desirability ($|\beta=0.23, p<0.01|$ > $|\beta=0.16, p<0.01|$). Like with the regulatory institutional environment, respondents in this study view the cognitive environment as being largely unfavourable for RE development. Therefore, the finding of a positive effect on entrepreneurial cognitions is important as it shows that the more individuals view the environment positively, they are more likely to develop confidence in their abilities to identify and exploit RE investment opportunities. This finding is in line with past research which relates to the effect of social capital, skills, support services and educational programmes on entrepreneurial intentions (Liñán, 2008, Chen *et al.* 1998, Chandler and Jansen, 1992, Peterman and Kennedy, 2003, Souitaris *et al.* 2007, Kolvereid, 1996, Kolvereid and Isaksen, 2006, Begley *et al.* 2005) though different from those reported by Lim *et al* (2010) who did not find any significant relationship between a country's educational system and willingness and venture scripts. Such contradictory results are also reported by Souitaris *et al* (2007) where no statistical significant results were found for the relationship between access to entrepreneurship development programmes and perceived behavioural control. Souitaris *et al* (2007) explain this unexpected finding by suggesting that individuals with already higher levels of perceived controllability were less likely to be influenced by an entrepreneurship programme. Given the significant results obtained in this study, it emerges that improving access to information, knowledge and skills related to RE investment can actually lead to improved

rates of entrepreneurship (Kostova 1997, Kostova and Roth, 2002) through increased levels of perceived self-efficacy and desirability of specific ventures.

Figure 5.2 shows that the last dimension of the country's institutional profile - normative institutional dimension has statistically significant effects on perceived self-efficacy but not perceived desirability of RE ventures. Social acceptability of entrepreneurship has a marginal effect while support of family friends and associational networks has the strongest positive normative effect on perceptions of self-efficacy providing support to the independent self construal argument put forward by Siu and Lo (2011).

The finding of a far more important role of the family, friends and associational networks on perceived self-efficacy of RE enterprises supports recent evidence provided by Baughn *et al* (2006a) who show that the impact of close friends and family is even more critical than general normative support in shaping individual perceptions in a three country study of the normative, social and cognitive factors affecting entrepreneurship in China, Vietnam and the Philippines. In effect they find that family support appears to be a major resource (providing capital and labour resources needed) and servs as a key factor influencing the decision to start a new enterprise. Boyd and Vozikis (1994) in their self-efficacy model also argue that entrepreneurial intentions are stronger and the probability of starting a new venture higher when individuals perceive that they have social support.

The lack of a significant effect of the normative environment on perceived desirability as shown in this study is similar to findings by Veciana *et al* (2005) but different from arguments put forward by Shapero (1984) with regards to the role of family and peers. Shapero argued that family could provide access to financial resources, moral support, labour, shared risk and necessary skills but also increase perceptions of desirability of new

ventures. There are a number of possible explanations why no relationship was found for the effect of the normative institutions on perceived desirability.

The "non-find" of the normative effect seems to provide further support to the independence self construal argument presented earlier (Gasson *et al.* 1988, Wallace and Moss, 2002, Willock *et al.* 1999, Ilbery, 1983, Gasson, 1973). It may be that individuals assess the potential economic (instrumental) and non-economic (intrinsic values) benefits of RE independently and when they are personally satisfied with the potential of the enterprise, they then may make use of family, peers and associational networks to implement the venture. Individuals are therefore likely to report higher levels of perceived self-efficacy if they believe they can mobilise the skills and resources needed to implement the action. It may also be as Burton and Wilson (2006) argue that because of the intrinsic value of independence, farmers may be unwilling to suggest in a questionnaire that they are under the social influence of others.

Cultures that place a high value on being in business, on entrepreneurship, and behaviours such as risk taking, innovation, independence, are more likely to spawn company formation than those which do not value these things (Shapero and Sokol, 1982, p.25). However, a number of authors have found that social norms are not important or have only a marginal influence entrepreneurial activity - United States (Krueger *et al*. 2000, Spenser and Gomez, 2004), Spain (Linan and Chen, 2009), UK (Mattison and Norris, 2007), US, Finland, and Sweden (Autio *et al.* 2001). Linan and Chen (2009) actually argue that the role of social norms on intentions may be stronger only in collectivist cultures. Picking up on this argument, Siu and Lo (2011) integrate two constructs from Singelis (1994) and Singelis and Brown (1995) – Independent self construal and interdependence self construal which mediate the influences of collectivist and individualistic values on individual behaviour in their study of entrepreneurial intentions amongst Chinese Students. Singelis

and Brown (1995) argue that people with independent self construal tend to focus more on their characteristics and goals than on the thoughts and feelings of others while people with higher interdependent self construal are more likely to act in accordance with the expectations of others and social norms. By integrating the self-construal constructs into intentions models, Siu and Lo (2011), finnd very significant positive influence of social norms on entrepreneurial intentions in China (collectivist culture). It may therefore be that individuals who place more value on independence like farmers, even in individualistic cultures like the UK are less likely to conform to general social norms when they form perceptions of what is of interest to them.

It is important to note that the reasons provided here are speculative and there is need for further research to confirm the findings. Worthy of note is that the studies with which the results of this study have been compared derive conclusions based on student samples. Students may have an idealised view of the institutional environment which is different from the experiences of individuals who are already operating businesses or those who already have established businesses like is the case for farmers in this research. From a methodological standpoint, some researchers use perceived desirability and feasibility as a single dependent variable to measure entrepreneurial interest (*not intention*) (Begley *et al.* 2005, Baughn *et al.* 2006a, Begley and Wee-Liang, 2001) with the assumption that feasibility and desirability questions are considered simultaneously in the venture creation process as posited by Krueger and Brazeal (1993). Such a methodological approach makes it difficult to compare the findings of this research and others especially because no significant interaction effects for the perceptual cognitions on investment intentions were observed. Another difference with Begley *et al* (2005) is that they found a negative relationship between regulatory support and entrepreneurial interest in their 13 country study of the effects of the politico-economic factors associated with interest in starting a business. They justified this finding by suggesting that government support may often

target large businesses hampering new business launches as people may be more interested in getting jobs in the large companies.

Overall, this research has shown that personal and contextual/situational variables have an indirect effect on entrepreneurship through influence on perceived self-efficacy and desirability. The intentions model developed in this study showed the relative impact of exogenous influences on intentions and ultimately venture creation (Krueger *et al.* 2000, Gnyawali and Fogel, 1994). By providing empirical support for the intentions model argues that promoting entrepreneurial intentions requires promoting perceptions of both feasibility and desirability (Krueger *et al.* 2000). The model helps to explain why some farmers have invested in RE and why others have not and for non-adopters, the study provides a basis to understand the factors which distinguish those with potential for investment and those with little potential. Researchers now have a well-developed theory based model which can be used to predict future RE investment behaviour. This is an interesting addition to the domain of RE policy and entrepreneurship as this study has tested and confirmed the fact that intentions models can be used to predict strategic decisions including the decision to diversify or grow an agricultural business (Krueger *et al.* 2000).

5.3. Implications for policy and practice

Results from this research show that the level of adoption of RE production and associated enterprises in the UK farm sector is low. This research provides further support to earlier findings by Sherrington *et al* (2008), Tranter *et al* (2011) and DEFRA (2012). The findings are similar to those of DEFRA but different from those of Sherrington *et al* (2008) and Tranter *et al* (2010) in that they highlight the fact that the levels of adoption are not uniform across all types of possible RE investment options. The study also reveals that up to 65% of current non-adopters had positive intentions towards these ventures. It emerges

that farmers are more interested in solar and wind energy production enterprises rather than biomass related ventures highlighting an possible mismatch between government priorities (as presented in the latest RE roadmap and the field reality (DECC, 2011b). The fact that farmers' intentions are biased towards solar and wind energy production suggests that the latest UK biomass strategy target (DECC/DFT/DEFRA, 2012) of increasing the areas of energy crops under cultivation by twenty by 2020 may not be achieved. This study has identified the constraints to investment including economic, regulatory, cognitive and normative barriers. It is less likely that the levels of adoption of biomass related enterprises more specifically will increase if the current barriers are not tackled. The findings obtained are therefore relevant for policy makers wishing to improve RE adoption rates as it may be important to review government priorities in line with the strategic intentions of potential investors. A robust model of effects was developed and tested which shows the determinants of investment intentions. An important implication of this is that by understanding how intentions are formed may provide the framework needed to stimulate adoption of RE production and associated enterprises.

This study has also revealed that farm level factors explained up to 17% of the variance in investment intentions. Generally, farmers with favourable resource bundles are more likely to show positive intentions towards RE enterprises. It also emerges from the study that farmers' attitudes are far more important determinants of future behaviour than farm level resources and the institutional context. For these reasons, policies cannot consider farmers to be a homogenous (Alsos *et al.* 2003) or coherent attitudinal group whose decisions are influenced more by external factors than internal factors as evidenced in past research (Tranter *et al.* 2011, Sherrington *et al.* 2008, Wilson, 1996). Government policies and programmes stand to yield higher benefits through targeting different groups of individuals with tailored/specific instruments (Reynolds *et al.* 1996, Alsos *et al.* 2003, Meert *et al.* 2005). In order to be more effective, government policy makers must first of all recognise

their own limitations as well as the particular obstacles faced by their firms (Manolova *et al.* 2008).

Government can use the scores obtained on each dimension and devise strategies for improving the institutional environment (Busenitz *et al.* 2000). This research has argued that it is the perception of entrepreneurs about the environment which shapes their actions. Gnyawali and Fogel (1994) suggest that it is the set of policies and actions of the government, the set of programmes and organisations which build the skill set of the country and society's admiration and support of entrepreneurship that influence opportunity and abilities to enterprise. This study has identified the relative importance of the external institutional factors and their effect on entrepreneurship in the RE sector.

Government can contribute to entrepreneurship by adopting policies and procedures that provide a broader scope of opportunities to entrepreneurs and enhance resource availability. Even though this study shows that the level of regulatory complexity did not influence investment intentions, there is continuous need to minimise the rules and regulations individuals need to follow to set up RE enterprises (Fogel, 2001, Gnyawali and Fogel, 1994). According to Begley *et al* (2005) government's role should be to facilitate dynamic markets, develop skills and stand back. Reynolds *et al* (1996) argued that the purposes of government programmes should be to encourage conception, facilitate gestation, growth and survival. Government can also increase rates of RE adoption by reducing regulatory complexity and facilitating easier access to finance (Lim *et al.* 2010, Convery *et al.* 2012, Huijts *et al.* 2012). The very recent planning relaxation for small scale RE systems in the UK is a very important step in reducing regulatory complexity and red tape in the process of setting up RE enterprises (NNFCC, 2012). According to the Department for Communities and Local Government (2012), small scale RE installations such as solar panels, biomass boilers, anaerobic digesters and wind turbines built on

agricultural or forestry land will from April 2012 be exempt from planning permission under amendments of the English Town and Country Planning Order on the conditions that the systems are certified by the microgeneration scheme.

The finding that social norms affect entrepreneurial intentions in this study suggests that government needs to take this into consideration when designing incentives and regulations. As Meek *et al* (2010, p.507) argue, government incentives can have an effect on improving perceptions of feasibility and desirability but socially enforced beliefs about RE may lead to a maximisation of the impact of policy seeking to encourage entrepreneurship or the adoption of environmental beneficial practices. In the short term, government can improve the normative environment by including such programmes as best RE entrepreneur of the year awards, provisions of trade fairs, and similar activities which reward entrepreneurial activities and increase overall societal awareness towards RE entrepreneurship. This research provides empirical evidence for role of social factors affecting investment intentions, family, friends and associational networks should be actively targeted and engaged in government policy programmes because "no farmer is an island" (DEFRA, 2008). Drawing from Meert *et al* (2005), the consolidation and fostering of social networks and easy access to government support is vital in guaranteeing on-farm diversification. In line with Meert *et al* (2005, p.96):

> 'any policy oriented towards the development of on-farm diversification (as is frequently integrated into national rural development plans in Europe) should not only include financial support but also be accompanied by serious effort to provide farmers with access to expert information and with opportunities to improve essential skills'.

The finding that the cognitive environment has an influence on perceptions of feasibility has important policy implications because self-efficacy perceptions are amenable to training (Zhao *et al.* 2005). Examples of useful activities to develop the cognitive environment are technical and skill development programmes and workshops especially

those which take the information to the farmer (Gnyawali and Fogel, 1994, McElwee, 2005, McElwee, 2008b, Manolova *et al.* 2008). According to Spenser (1996), governments can improve the cognitive environment by considering policies to provide education and training programmes to potential entrepreneurs or help disseminate knowledge and about how to set up and run new enterprises. There are many organisations providing advisory, extension and skill development services to farmers on RE issues in the UK. The most prominent are government departments, non-department public bodies and quasi autonomous government agencies (Slade *et al.* 2009, Taylor 2008). These education and training systems encourage individuals to start up RE initiatives. Results from this study revealed that respondents viewed information about RE in the UK to be largely conflicting suggesting the need for coherency. The farm press in the UK is generally supportive of RE on farms (Farmers Weekly, 2012) and initiatives like the RE support service put in place by the NFU[15] for its members are other ways in which farmers can access information (NFU, 2012). It is increasingly recognised that appropriate promotion of policies and training of farmers on RE subjects is needed to increase levels of adoption of RE (Mattison and Norris, 2007).

This research shows that farmers' perceptual cognitions are very important factors influencing future behaviour. They are far more important determinants of future behaviour than the effects of the country's institutional profile, the farmer's personal situation and farm business characteristics. Policy makers need to recognise and respond to this and work towards designing policy instruments and programmes which improve perceptions of desirability and self-efficacy. In effect RE policies cannot therefore once again be limited to subsidies or imposed top down strategies (Bygrave and Minniti, 2000, Minniti, 2008). The existence of significant results for perceived self-efficacy and

[15] The results of this study were presented to the Deputy President of the NFU prior to the launching of the NFU RE Support Service

perceived desirability proffers support to the idea that farmers' attitudes play an essential part in adoption decisions and must be taken into consideration when policies regarding participation of farmers in environmental programmes are developed (Battershill and Gilg, 1996a, b, Mattison and Norris, 2007, Wilkinson, 2011, Tate *et al*. 2012).

For farmers,

> 'there is a growing demand for not only changes in food production techniques, but also in non-agricultural functions and services in response to climate change, a reduction in oil-based energy resources and a universal food crisis. These shifts in production, strong emerging new markets which represent both severe pressures and open new opportunities for farmers, requires adaptation strategies, increased innovation, and entrepreneurship. Increased farm diversification is a necessary development requiring farm and rural business support schemes and policy. A major challenge for the agricultural sector is to enable farmers to develop their entrepreneurial skills' (McElwee and Bosworth, 2010, p.834).

The agricultural sector is key in realising the UK RE potential (DECC/DFT/DEFRA, 2012). It has been argued that entrepreneurs can be discouraged from investing if they have to comply with too many rules and procedural requirements, are expected to report to a wide range of institutions and have to spend a substantial amount of money and time on what is seen as 'red tape' (Bruton *et al.* 2010, Tate and Mbzibain, 2011). Any lack of familiarity with the different support mechanisms and an increased perception of risk is likely to make RE a less attractive proposition for investors (Connor, 2003). This study supports the view by Sherrington *et al* (2008) that farmers decision making is a key constraint to widespread deployment of RE in the UK especially energy crops. For potential RE investors the study emphasises the need to be aware of the different constraints and pressures involved in the RE investment process given the evidence that these enterprises can contribute towards farm business performance. Farmers have to develop adequate responses to deal with them (Manolova *et al.* 2008). In the same direction, an investigation of the non financial barriers to RE investment in Europe, Masini and Menichetti (forthcoming) found that the analysis of the factors would be helpful for

investors to have a more balanced view of the risks and opportunities in the RE industry. The importance of perceptual cognitive factors revealed in this research calls for entrepreneurs to be aware of these and the factors which influence them. They need to be attentive to these factors and seek to understand how they exert influence in their decision making processes.

Clearly this study demonstrates that entrepreneurial farmers are able to respond to external factors which influence their behaviour. For example, the high incidence of farmers who invested in solar or the high level of interest in wind and solar shown by potential investors revealed that farmers responded to the introduction of feed in tariffs and the renewable heat incentive (Tate *et al*. 2012). Farmers were motivated by the need to cut costs, diversify farm business incomes and contribute to government energy and climate change targets. It is evident that diversification into RE enterprises is more than just a strategic management decision for farm entrepreneurs (Walley *et al.* 2011, Mbzibain *et al.* forthcoming). It entails giving consideration to the continuous viability of a farm. From the view point of sustainability an adequate mix of enterprises can lead to greater efficiency in the use of limited resources (Anosike and Coughenour, 1990).

This study highlights a very high level of interest in RE enterprises with 65% of respondents stating that they would invest in RE within the next five years. This is a very high level of interest and a key challenge is to convert these potential investors to realise their investments. Sherrington *et al* (2008) argue that this can be achieved by providing farmers with independent and trusted information to help them take their decisions. Villamil *et al* (2012) suggest that high quality information must be communicated with high stakeholder involvement. This suggests putting farmers at the centre of information dissemination campaigns. Past research has shown that early adopters of RE have an influence on the behaviour of non-adopters of these technologies (Panousou, 2008).

Covery *et al* (2012) show that farmers often adopt a “wait and see” or “follow the leader” approach to RE adoption. They argue that the lack of leaders to follow in a particular community may reduce perceived attractiveness of the enterprises and hence adoption. Therefore, using early adopters to share their experiences will be a useful way to improve RE adoption. Villamil *et al* (2010) propose that for this to be effective, preferred modes of farmer-researcher workshops, field days, on farm demonstrations, participatory farm research and farmer led groups should be used. It is unlikely though that this sort of action will emerge spontaneously. Rural support schemes, consultants, researchers and national government can play an important role in facilitating these processes through needs identification and provision of resources necessary to bring farmers together.

5.4. Chapter summary and link to chapter 6

This chapter presented the findings emerging from this study. The results were discussed in line with extant research and areas of convergence and divergence between this study and other existing studies were identified. This chapter demonstrated empirically that the rate of uptake of RE enterprises on UK farms was low. However, when evaluated by type of RE enterprise, this research found that solar, wind and biomass firing were the most popular enterprises adopted while energy crops and anaerobic digesters were the least prevalent amongst respondents. Current adopters showed that the RE enterprises had a positive effects on farm business performance (turnovers) as reports showed that up to half of respondents indicated contributions ranging from between £1 to £25,000. When asked about the motivations for adoption, this research showed that the objectives were entrepreneurial in nature. The main barriers identified to adoption were economic, regulatory, cognitive and normative in nature.

This study also assessed the intentions of current non-adopters and found that 66% of 338 respondents had positive intentions towards RE enterprises. When the strategic preferences of these non-adopters were questioned, it emerged that the responses were biased towards solar and wind enterprises which immediately showed a mismatch between government RE priority areas and investor interests. Based on the comprehensive model developed in section 2.8.4 chapter 2 and the accompanying hypotheses, the study provided strong support for the use of intentions based models in predicting future behaviour.

This research revealed that the farm level resource base (farmer's personal situation and the farm business resource base) had a strong significant effect on entrepreneurial intentions. It emerged that the degree of diversification on the farm, the educational attainment of the farmer, the land tenancy status as well as the agricultural business turnovers were the most significant factors influencing intentions. This research found that informal rather than formal institutions had the most significant influence on entrepreneurial intentions. It provided evidence of the existence of moderation effects between different dimensions of a country's institutional profile and entrepreneurial intentions. Contrary to expectation, the regulatory institutions were not directly related to entrepreneurial intentions while the normative institutional dimensions (general society's acceptability of entrepreneurship) had a significant negative effect on entrepreneurial intentions. It also emerged that farmers' attitudes had the most significant positive effect on entrepreneurial intentions and mediated the relationships between external exogenous farm and institutional variables and entrepreneurial intentions in support of established foundation theories adopted in this study. The next chapter (6) will present the conclusions arrived at through this study emphasising the contributions to knowledge, limitations of this research and suggestions for future studies.

Chapter 6: Conclusion, contributions and suggestions for further research

6. Introduction

Chapter 5 of this document discussed the results presented in chapter 4 alongside existing research outcomes. Through this discussion, points of convergence and divergence with established literature were highlighted as well as the knowledge gaps filled by this study. In this chapter, the concluding thoughts of this investigation are presented. The chapter is organised in four sections starting with section 6.1 which presents the conclusions drawn from both the secondary and primary research. Section 6.2 illustrates the impact of the study in terms of its contribution to knowledge while section 6.3 presents the limitations of the study with suggestions for future research. The chapter ends with a summary which is a reprise of the research issues and the principal findings.

6.1. Conclusions of the research

The aims of this research were to evaluate the level of adoption of RE ventures on UK farms, to investigate the contribution of RE production and associated enterprises to farm business performance, motivations and constraints to adoption and to determine the factors which influence RE investment decisions. A detailed review of RE policy, entrepreneurship and farm entrepreneurship research revealed many weaknesses in the understanding of factors affecting the development of RE in the UK farm sector, the paucity of knowledge with regards to what triggers entrepreneurialism on farms and the scarcity of extant literature on farm entrepreneurship more generally.

Past RE policy research provided the framework to achieve the first four aims of the study. A thorough exploration of the literature led to the development of a comprehensive theoretical framework and hypotheses to examine the factors affecting investment intentions. This model drew inspiration from the Resource Based View (Alsos *et al.* 2003,

Alsos and Carter 2006, Wernerfelt 1984, Wernerfelt 1995), the Theory of Planned Behaviour (Fishbein and Azjen, 1973, Azjen, 1991), Shapero and Sokol's entrepreneurial event (SEE) model (Shapero and Sokol, 1982, Krueger, 1993), entrepreneurial intentions models (Krueger and Brazeal, 1994, Krueger *et al.* 2000), Social Cognition Theory (Bandura, 1977, 1986, 1999) and finally institutional theory (Scott, 1995, 2008, Kostova, 1997, Busenitz *et al.* 2000, Prieto *et al.* 2010). Building the model on a wide range of theoretical foundations ensured that the most relevant factors affecting entrepreneurial intentions were considered with the view to obtaining a finer grained understanding of the "black box" - farmers' RE investment intentions' than has been undertaken previously.

Given that the aims of this study were descriptive and causal in nature, a research design was developed to achieve them. An initial pilot survey of 7 farmers in the West Midlands Region of the UK led to the development of the data collection instrument for the quantitative postal survey phase of the study. In developing the data collection instrument especially with regards to determining the factors affecting entrepreneurial intentions, care was taken to build in questionnaire items from established studies. A pre-test was realised by visiting the 7 farmers involved in the pilot survey and instrument validity was further ensured by subjecting the instrument to scrutiny by researchers knowledgeable in RE and entrepreneurship research at the NFU, University of Wolverhampton Business School, Manchester Metropolitan University and Warwick Business School. A few modifications were made after the pre-test leading to the postal questionnaire survey of 2,000 farmers randomly selected from a list of 5,111 active members of the NFU in the West Midlands Region of the UK. A total of 412 questionnaires were returned by the cut-off date. 393 usable responses were retained representing a response rate of 20.1% which was judged acceptable. Non-response bias and representativeness analysis revealed that the sample was broadly representative of farmers in the UK when compared to official DEFRA 2009 agricultural statistics as well as farm business survey 2010/2011 reports. Based on the

random sampling approach adopted, the response rates achieved, non-response bias minimised and representative ensured, generalizability of the results of this research is guaranteed.

The model presented in section 2.8.4 chapter 2 proposed that investment intentions were influenced by external variables (the farmer/farm resource base, institutional) as well as individual level cognitive variables. To proceed with the analysis of effects, validity and reliability analysis of the constructs was performed. In the first instance, the items developed to measure the institutional dimensions, were subjected to principal component analysis. PCA revealed five uni-dimensional constructs with adequate internal reliabilities (Cronbach alphas above 0.60 – Brace *et al.* 2009). 10 items designed to measure individual attitudes towards entrepreneurship were also subjected to PCA. The items loaded cleanly on two dimensions as expected and internal reliability analysis also showed that the factors were very adequate. Given that the measures of the farmers' traits and farm business characteristics were ordinal and nominal variables, dummy coding was undertaken following the procedure established by Hair *et al* (1998). After verifying that the assumptions for regression analysis were met, statistical analysis was undertaken using a combination of multivariate linear regression and path analysis to test for different effect hypotheses. Mediation analysis was undertaken using the approach proposed by Baron and Kenny (1986). The levels of achievement of the research aims are presented below.

Research aim 1: Deployment of RE on UK farms

Of the 393 usable questionnaires retained for analysis in this study, 55 (14%) out of the 393 survey participants had adopted some form of RE enterprise. The 14% positive responses were disaggregated by RE type showing that solar and biomass firing ventures were the most popular ventures adopted while energy crop production and anaerobic digestion was the least prevalent. The DECC/DFT/DEFRA (2012) affirms that biomass

production needs to increase significantly and sustainably if the energy and climate change targets and ambitions are to be met. It is unlikely that this is going to happen following the results of this study.

Research aim 2: Contribution of RE to farm business performance

Of the 55 survey participants with operational RE production ventures at the time of the study, 44% said that farm business performance remained the same after adoption, half of the current adopters reported slight to significant improvements in farm business performance in 2009. In financial terms, up to 24% were unsure of the financial value of the contributions brought about by RE production on farms. Up to 35% of respondents reported incomes of between £1- £10,000 while another 2% suggested that the contribution of RE production and associated enterprises could be estimated at above £25,000 turnover in 2009. This study therefore provides evidence that RE production has potential to contribute to farm business performance and survival. While acknowledging these financial contributions, this study did not investigate the wider environmental and social welfare benefits related to these enterprises which would have shown significant higher returns on RE production on farms.

Research aim 3: Types of RE ventures accessible to farmers

This study finds that solar energy ventures are the most popular types of ventures reported followed closely by biomass boilers while some 13% had wind turbines on farms. Other biomass related enterprises account for 40% of those adopted. The incidence of these enterprises is quite evenly spread with Miscanthus (9%), short rotation coppice (7%), micro combined heat power (9%), and woodchip/pellet production (9%). The least prevalent types of enterprise are anaerobic digesters adopted by only two out of 55 adopting farmers (4%). Other types of enterprises suggested include hydro, ground source heat pumps, timber wood burners and forestry. Anaerobic digestion is the least adopted RE

enterprise because of the higher initial outlays required and the planning/permitting requirements for setting up this particular type of enterprise.

This research shows that most adopters used personal savings (38%) and business reserve funds (34%) in order to invest in RE. Only 7% accessed government financial support while 5 others obtained funds from family sources. It was found that farmers with 100 ha and above and operating mainly owned lands were the most represented to have accessed loans from banks. They were also more likely to report using business resources. None of the farmers below 35 received loans or grants for investment. It appears from the results that more resource capable farmers were more likely to invest in RE because of higher chances of having farm business financial reserves, material resources, access to loans and government subsidies.

Research aim 4: Motivation for adoption and barriers

It emerges from the current study that farmer' investment decisions are guided by entrepreneurial motives as a means to improve the viability of enterprises through diversified RE markets. To diversify farm incomes, cut farm business costs, take advantage of market opportunities and provide environmental benefits are the most important reasons for adoption (possible adoption). Taking advantage of government grants was more likely to be raised by current non-adopters than current adopters. Helping to meet government energy and climate change targets was not viewed as being very significant while there was even less emphasis on the ability of RE production and associated enterprises to assist with the disposal of farm waste. Other motives such as preparing for retirement, ensuring long term financial security, making use of existing farm resources as well as improving social acceptability of the farm enterprise were also highlighted by survey participants.

An analysis of 193 responses relating to investment constraints shows that some broad categorisation of the barriers is adequate. Close to half of the responses were identified to be economic in nature, 45 were related to regulatory/cognitive issues, while the rest were related to normative and social acceptability of RE enterprises. As regards economic barriers, high investment costs, unsuitable farm situation, tenancy, unsure economic benefits and long payback periods are the most significant barriers raised. Lack of market outlets, high commodity prices and difficult access to credit are surprisingly the least important barriers reported.

The most important regulatory problem raised relates to planning, red tape and lack of trust in government policy while cognitive barriers are the lack of information about different financial support packages, lack of knowledge and skills and finally the "unproven" nature of some RE technologies. Concerns about age and lack of social acceptability of RE enterprise (visible impacts, public/neighbour opposition) are seen as additional barriers for investment. A few other farmers suggest that they could not take on additional enterprises because of lack of management time.

Research aim 5: Factors influencing farmers' intentions to invest in RE ventures

Part 3 and 4 of chapter 4 presented results of the factors which influence farmers' intentions to invest in RE production and associated enterprises. Results show that the model developed is robust and explain a significant proportion of the variance in the independent variable. It emerges that farmers' attitudes have the most significant influence on intentions and as proposed in the model (section 2.8.4) and mediate the relationships between external factors and farmers' investment intentions. The summary of proposed relationships can be found in table 6.1.

Table 6.1: Summary of support found for research hypotheses

Hypothesis	Support
H1: The farm business resource base will influence farmers' intentions to invest in RE ventures	Supported +
H2: The country's institutional profile will influence farmers' intentions to invest in RE ventures	
H2a,b: The influence of the regulatory institutional dimension on farmers' investment intentions	Not supported+
H2c: The influence of the cognitive institutional dimension on farmers' investment intentions	Supported +
H2d,e: The influence of the normative institutional dimension on farmers' investment intentions	
H2d: The influence of society's acceptability of entrepreneurship on farmers' investment intentions	Supported -
H2e: The influence of family, friends and associational networks on farmers' investment intentions	Supported +
H3: There are co-dependencies between the different dimensions of the country's institutional profile in their influence on farmers' investment intentions	Supported +
H4: Farmers' perceived self-efficacy and desirability of RE ventures will influence their intentions to invest in RE ventures	Supported +
H5: There are interaction effects between perceived self-efficacy and perceived desirability of RE ventures in the influence on investment intentions	Not supported-
H6: The influence of the farm business resource base on farmers' intentions will be mediated by perceived self-efficacy and desirability of the RE ventures	Supported
H7: Influence of the country's institutional profile on farmers' intentions will be mediated by farmers' perceived desirability and self-efficacy	Supported

6.2. Contributions of this study to knowledge

This study makes several contributions to knowledge. This study confirms that the rate of adoption of RE on UK farms is still low suggesting that government agricultural; energy and climate change targets may not be achieved. However, it emerges that the rate of adoption is not uniform as some enterprises are more prevalent than others. Solar energy ventures are the most prevalent while anaerobic digestion is the least observed in the study.

More than half of current adopters of RE ventures reported improvements to farm business turnovers. It can be said based on this finding that RE enterprise can effectively contribute to farm business viability and sustainability and therefore represent an interesting diversification option for farmers. The motivations for RE adoption are identified as entrepreneurial in nature. Similar results are found for non-adopters but for the fact that those who are interested are also motivated by the availability of government grants and subsidies. This study identifies the most important constraints to investment – economic, regulatory, cognitive and normative barriers.

This research shows that farmers have a very high level of interest in RE production on farms because 65% of the 338 non-adopters say the intended to invest in RE production and associated enterprises. Adopters are more likely to be better educated and younger than non-adopters. The farm business is likely to be fully owned, involved in cereal production rather than dairy, be diversified and having higher business turnovers/farm sizes. Potential adopters are more likely to report higher levels of self-efficacy and to view RE as being personally desirable than non-adopters. Sherrington *et al* (2008) argue that adoption of RE technologies is akin to adoption of innovations and as such the results of this research are largely supportive of earlier studies on the adoption of agricultural innovations.

One of the main contributions of this study is that a more comprehensive RE investment intentions model has been developed and tested comprising a broad range of measures than has been done previously especially the fact that it integrates the key role of psychological and behavioural factors which has been identified as a shortcoming in extant literature (Mattison and Norris, 2007, Masini and Menichetti, 2012, Huijts *et al.* 2012, Wüstenhagen and Menichetti, 2012, Tate *et al.* 2012). This is also the first study to investigate the joint effects of formal and informal institutions on RE investment intentions using the notion of the country's institutional profile. New constructs have been developed to measure the country's institutional profile including regulatory support for RE, regulatory complexity, cognitive institutions, social acceptability of entrepreneurship and support of family, friends and associational networks. Multiple regression and path analysis were used to test the veracity of the model. The results reveal that the model developed is robust and efficacious and explain a high portion of the variance in the dependent variable. It is the first empirical study to examine RE investment intentions from an entrepreneurship perspective. The model provides a framework to assist the government and stakeholders to identify the strengths and weaknesses of the institutional environment and develop specific strategies to mitigate the weaknesses identified.

A number of significant contributions emerge from statistical verification of the model. With regards to the effect of contextual factors on investment intentions, this research shows that regulatory support for RE and regulatory complexity factors did not have any direct influence on investment intentions. The fact that regulatory complexity do not have any influence on investment intentions suggests that problems of red tape and procedural requirements may be overstated in RE research.

Secondly, the country's cognitive institutional environment have a statistical significant influence on investment intentions though respondents in this study view this environment as being largely unfavourable towards RE development.

Thirdly, this research provides strong empirical evidence for the effect of normative institutions on farmers' investment intentions. The normative institutions are related to general society's acceptability of entrepreneurship and the support of family, friends and associational networks. Very few studies have been able to demonstrate the effects of social norms on entrepreneurship. With much of policy research focused on the regulatory institutional environments, Manolova *et al* (2008) and Alvarez *et al* (2011), this study provides a micro level empirical evidence to confirm the existence of normative influences on RE investment intentions in the UK. Empirical evidence of the impact of social norms supporting or restricting environmental entrepreneurship is relatively new and so this study adds to the literature on the effect of socio-cultural factors affecting entrepreneurship (Baughn *et al.* 2006a, Meek *et al.* 2010, Sequeira *et al.* 2007) in the UK farm sector.

This research shows that general society's support for entrepreneurship is a consistent, albeit negative, and unmediated predictor of investment intentions. Given that farmers place a very high value on independence, the study speculates that individuals with very high independence self-construal are less likely to conform to general society's perceptions about their activities. By also focusing on proximal level normative support, this study establishes that support of family, friends and associational networks have the highest influence on individual perceptions of feasibility but not desirability providing additional support to the independence self construal argument. The normative institutional constructs exert significant effects on individual perceptions of feasibility suggesting that the normative environment could complement the cognitive and regulatory dimensions in providing the skills and resources required for new venture creation. This is interesting

because respondents in this study viewed the normative institutional environment to be more favourable than the cognitive and regulatory institutional profiles. The strong influence of the normative institutions on entrepreneurial intentions as demonstrated in this study, provides further support to the arguments that the degree to which a society admires entrepreneurs may be a reliable measure of domestic entrepreneurship than more general cultural measures (Kostova 1997, Kostova *et al.* 2008, Busenitz *et al.* 2000, Manolova *et al.* 2008, Kostova and Roth 2002). This study is unique in that it not only considers general normative support for entrepreneurship as defined by the country's institutional profile, but also extends normative support to that of close relationships (Sequeira *et al.* 2007, Prieto *et al.* 2010, Baughn *et al.* 2006a, Baughn *et al.* 2006b). By obtaining consistent significant results for both types of norms actually suggests that future research may provide more complete explanation of normative institutional effects on entrepreneurial intentions by integrating both types of measures.

Fourthly, past research posited the potential existence of co-dependencies between different dimensions of a country's institutional profile and the levels of entrepreneurship in a country (Spenser and Gómez 2004, Dacin *et al.* 2002, Baughn *et al.* 2006b). This study is the first to provide empirical evidence for the existence of interaction effects between different dimensions of the country's institutional profile and their effect on entrepreneurship in the UK farm sector. The existence of a positive interaction effect shows that social acceptability of entrepreneurship could play a far more important supplementary role on the effect of formal policies on farmers' investment intentions than previously thought. The existence of a moderation effect also suggests that future studies on the determinants of entrepreneurial activity should not only examine the effect of formal regulatory institutions on entrepreneurship but should also include the wider social/informal institutions which also facilitate entrepreneurs' efforts to discover and exploit opportunities that are created by relevant market failures (Dean *et al.* 2007, Dean

and McMullen 2007, Meek *et al.* 2010). Based on this empirical evidence, this research shows that what may really matter to drive up RE investment in the UK farm sector is to have a favourable cognitive and normative environment (Kostova and Roth, 2002). This study establishes that informal institutions and not formal institutions may play a far more important role in promoting the development of RE than has been previously thought (Alvarez *et al.* 2011).

Another important contribution of this research is that two new measures of perceived self-efficacy and desirability of RE ventures have been developed with adequate internal reliabilities. This study finds that these factors have the most significant influence on individual investment intentions over and above personal, farm business resources and institutional factors put together. Mediation analysis using the Baron and Kenny (1986) procedures shows that perceived self-efficacy and desirability mediate the effect of external variables on RE investment intentions. By finding that external/exogenous variables influence RE investment intentions only through their influence on individual cognitions contributes to open up the "black box" of entrepreneurial intentions (Mitchell *et al.* 2000, Mitchell *et al.* 2002). For example, perceived self-efficacy was involved in all cases of full mediation further emphasising the encompassing role of this construct (Bandura, 1977, 1986, 1999, Azjen, 1991, Prieto *et al.* 2010).

The existence of mediation effects confirms the thesis of this study that external factors influence RE investment intentions only indirectly through their impacts on perceived self-efficacy and desirability. A clear illustration of this argument is that regulatory support for RE did not have a direct influence on investment intentions but path analysis showed that regulatory support was statistically positively associated with perceived self-efficacy and desirability. Cognitive institutions also have a significant positive effect on attitudes towards entrepreneurship while the normative institutional factors have significant effects

only on perceptions of self-efficacy but not desirability. From a conceptual standpoint these results support the sociological/institutional (person in situation) approach which stresses the important influence of external factors on the decision to start an entrepreneurial venture (Shapero and Sokol, 1982, Aidis *et al.* 2008, Veciana and Urbano, 2008). In line with the arguments put forward by Krueger *et al* (2000), results of this research confirm that taken individually, individual level variables (personal and farm business characteristics) as well as situational variables (institutions) provide little influence on investment intentions.

This study overcomes one major weakness in entrepreneurship which is that of testing intentions using student samples. It goes beyond general entrepreneurial intentions and includes subjects that are faced with making investment choices in a specified future time period. Krueger *et al* (2000) suggests that intention models are most useful when they target specific types of ventures. The model developed in this thesis is comprehensive and has shown strong predictive power. Future studies on farm entrepreneurship now have a model to test entrepreneurial behaviour in the farm sector. Given that this is the first time this type of model is developed and tested for the RE investment intentions, future research may also use this model to test entrepreneurial activity in other sectors.

This study also calls for researchers to make use of farmer samples to study entrepreneurship. In effect Carter (1998) and Willock *et al* (1999) suggest that farmers are a rich reservoir for research which is often neglected. Literature on the emerging area of farm entrepreneurship is scarce as calls for research have not led to widespread investigation (McElwee, 2006). By bringing together literature from the separate areas of “farm” and “entrepreneurship” this study contributes to fill this gap. This investigation contributes to knowledge of the factors which trigger entrepreneurialism on farms (Alsos *et al.* 2003, Alsos and Carter, 2006, McElwee and Baxter, 2005, Vesala and Vesala, 2010).

This study also paints a clearer picture of the reasons why some farms diversify and others do not (Ilbery *et al.* 2006) - that farmers' attitudes towards entrepreneurship measured by perceptions of self-efficacy and desirability are the most important factors which distinguish those who are entrepreneurial and those who are not.

6.3. Limitations of the study and directions for further study

The use of postal quantitative surveys suffers from a number of limitations. Firstly, problems of poor response rates may lead to biased results (Armstrong and Overton 1977, Bartholomew and Smith 2006, Brennan and Charbonneau 2009, Goodstadt *et al.* 1977, Heberlein and Baumgartner 1978). This study however obtained an acceptable response rate and non-response bias analysis revealed that the respondents in this study were generally similar to non-respondents. By comparing key respondent characteristics with known statistics from official government sources, this study shows that the sample is also similar to overall national distribution (DEFRA, 2010, FBS, 2011) suggesting appropriate representativeness and generalizability of research results.

Another weakness of using postal surveys is the inability to ask follow up questions and to explore in more depth the reasoning behind the findings. Qualitative research may provide rich exploratory information which could add value to the survey (Segal *et al.* 2005). Studies of this kind may also suffer from self report bias. Self report bias exists when individuals are inclined to report socially desirable actions or to deny performing socially undesirable actions (Sequeira *et al.* 2007). This tends to happen when survey participants are asked to reveal sensitive information about their intentions or actions. However, Azjen (1991) suggests that self reports are generally accurate when the behaviour of interest is not of a sensitive nature. No sensitive information was collected in this study and as such we believe that self report bias was minimised. A similar problem is that of common method bias which may result from asking the same respondents questions related to the

dependent and independent variables (Podsakoff *et al.* 2003). Harman's single factor test showed that this was minimised in this study.

Thompson and Tansey (1982) claim that intention surveys may also suffer because of respondent bias. They argue that farmers' responses may be biased if they see their participation in the survey as a way to influence policy. This is unlikely to happen if the questions are framed in a research mode such as was the case in this study rather than to obtain a policy evaluation (Bougherara and Latruffe, 2010).

There is significant potential for future research emerging from this study. The study is cross-sectional and thus has similar problems to any cross-sectional study, in that it may be time specific and does not enable full examination of the dynamic interplay the factors affecting investment intentions and the process of institutionalisation. This is important as intentions and the factors that influence them may change before the behaviour being investigated actually takes place (Azjen, 1991, Thompson and Tansey, 1982). These concerns are similar to those raised by Vare *et al* (2005) in their study of farm succession intentions-behaviour discrepancy in Finland. Despite these concerns, well-constructed surveys of farmers' intentions have been seen as constructive because follow up studies have shown that the majority of farmers actually go on to implement their intended behaviour (Tranter *et al.* 2007, Gorton *et al.* 2008). Even though Thompson and Tansey (1982) and Vare *et al* (2005) raise concerns about discrepancies between planned and actual behaviour, their studies actually found that a good proportion of their respondents actually implemented the planned behaviour. Vare *et al* (2005) found that 297 out of 384 respondents (85%) actually carried out the intended behaviour. A useful extension of this study will be to carry out a longitudinal study to evaluate the extent to which the 65% of potential adopters actually invest in RE within the next five years. The key drivers of social

acceptability, policy, oil and commodity prices have to be monitored to examine the degree to which they bridge/widen the gap between stated intentions and actual actions.

This study found that farmers' preferences with regards to RE enterprises are not uniform. This result when compared to recent research by the UK government (DECC/DFT/DEFRA, 2012) and Covery *et al* (2012) point to the view that location and geography may have an impact on adoption behaviour. Given that this study was focused only one of the seven DEFRA regions in the UK, research will benefit from carrying out a national comparative study with a wider range of farmers. The concerns of climate change, energy dependency and farm business viability are not limited to the UK. Identifying the challenges faced by farmers to diversify to RE in the EU and other developed countries remains relevant for policy makers wishing to expand the use and adoption of RE energy. The model developed in this study should be tested in an EU wide sample.

The farmer's intention to invest in RE enterprises was used as dependent variable in this study. Clearly, the fact that farmers' preferences were heterogeneous suggests that the factors affecting adoption of specific RE options may be different. For this reason, further investigation using the model should evaluate the extent to which the independent variables influence the strategic preferences. This is important following the recent evaluation of non-financial barriers affecting RE investment decisions carried out by Masini and Menichetti (forthcoming). The authors find that different non-financial factors affect the strategic RE investment decisions taken.

The Theory of Planned Behaviour remains a very important framework for researchers and policy makers investigating the future behaviour of farmers on a wide range of issues ranging from technology adoption, conservation, erosion control…. The model developed in this study provides a robust option to study future behaviour. A possible extension of

this study is to use the proposed model to study farmers' willingness to adopt different types of diversification/specialisation activities. A comparative study using the TPB and the proposed model should be carried out. This will further highlight the usefulness of the entrepreneurial event approach to adoption studies.

All through this research, the notion of farmers' entrepreneurial skills have been very recurrent. Past research argues that building entrepreneurial skills remains a key challenge for policy makers (McElwee, 2005). The study shows that there is a mismatch between farmers' information needs and what they have access to. Up to 80% of respondents in this study indicated that information about RE was largely conflicting. It is important for research to identify the specific skills (basic and strategic) that farmers need as well the most preferred information sources. By so doing, specific information campaigns and approaches can be developed taking into consideration the fact that farmers are not a homogenous category of investors.

It is fair to mention that the barriers to investment identified in this study are not absolute. However, the results of this study do not provide any ordering or rank the problems identified. For this reason, it is difficult to state which are more important and urgent to be tackled. A study that provides an idea of importance and urgency will be useful as it will enable farmers and policy makers to prioritise resources and focus on the most pressing constraints to widespread adoption.

Past research has also shown that farmers' goals and values influence farm level decision making (Gasson and Potter, 1973, Willock *et al.* 1999). Future research using the intentions model developed in this research, may include these variables into the model to test whether they increase the explanatory power of the model. The 48% explanatory power achieved from testing the model is good but also shows that 52 percent of the

variance was not explained by the factors employed. One issue is that a number of variables used had internal reliabilities below 0.7 (cognitive institutional dimension, perceived desirability of RE enterprises). Future research should refine these measures by increasing the number of items used to develop more internally reliable items. Even though farmers indicated that one of the main reasons for investing or intending to invest in RE was to cut farm business costs, further research would benefit from understanding the real farm energy costs and the extent to which the farm's energy consumption affects willingness to invest in RE enterprises.

It is also acknowledged that the types of relationships which have been considered are simple and linear whereas intuitively, the interactions between the different variables used in this study can be very complex. As such the limitation of using multiple linear regression analysis is acknowledged (Prieto *et al*. 2010). It may be interesting to test the model using more complex statistical tools like structural equations modelling to further confirm the results obtained.

In this study, the joint effects of normative and regulatory institutional factors on farmers' investment intentions were examined and interesting insights into the complementarities between formal and informal institutions were revealed. Research may further this type of analysis by considering other types of interaction effects and their effects on levels of entrepreneurship. More studies are required on the effect of normative institutions on RE investment intentions as it emerged that social acceptability of entrepreneurship in this research was negatively significantly related to RE investment intentions which was contrary to expectation. Even though speculative explanations using the independent self construal argument were made, it is still relevant to investigate this further.

The economics of RE production on farms remain an interesting area of future research. Future research may consider the extent to which the financial viability of the RE influences investment decisions. This study found discrepancies between farmers responses regarding the perceived and objective financial contribution of RE to farm business performance. It may be useful to carry out quantitative case studies to establish the actual contribution of RE production and associated enterprises to farm business performance using project appraisal tools such as net present values, internal rates of return, return on investment and payback period analysis (Tharakan *et al.* 2005).

6.4. Final conclusion

In conclusion, this study contributes to fill a number of knowledge and research gaps with regards to the key factors affecting the role or potential role of the farm sector in achieving the UK's energy and climate change objectives. It fills an important knowledge and research gap with regards to the factors which trigger entrepreneurialism in the UK farm sector specifically with regards to investment in RE enterprises. The study demonstrates that the rate of adoption of RE on UK farms is low and that the rate of adoption by type of RE enterprise is not uniform. The study finds that farmers are more interested in solar, biomass firing and wind energy production enterprises as opposed to energy crop and anaerobic digestion enterprises casting doubts on the ability of the RE road map and biomass strategies to promote further development of the RE sector.

The study shows that RE enterprises provide a boost to farm business performance either through energy savings and sales of energy products providing support to the argument that RE production represents an interesting diversification option. On this issue, the reasons for adoption were found to be entrepreneurial in nature. Most respondents were

interested in improving farm business performance, cutting costs and taking advantage of business opportunities in the RE sector.

An assessment of the levels of intentions of current non-adopters of RE enterprises revealed that 66% out of 338 had positive intentions towards RE enterprises showing a very high level of interest. This study developed and tested a robust RE investment intentions model drawing from a wide range of theoretical fields. To test the RE investment intentions models, five reliable institutional profile constructs were developed – regulatory support for RE development, regulatory complexity, cognitive institutions, social acceptability of entrepreneurship and normative support of family, friends and associational networks. Two attitudinal constructs – perceived self-efficacy and perceived desirability of RE enterprises were also developed with very adequate internal reliabilities. Rather than considering the farm resource characteristics as control variables, this study considered these as an important resource base at the centre of farm level investment decision making. Regression analysis led to a number of other important contributions to knowledge, research and practice.

With regards to the farm level resource base, the study demonstrated that these factors were very important influencers of RE investment intentions, perceived self-efficacy and perceived desirability of RE enterprises.

With regards to the effect of the country's institutional profile on entrepreneurial intentions, this study is the first to apply a comprehensive institutional framework (Busenitz *et al.* 2000) to the study of farmers' intentions in the UK. It provided the first empirical evidence for the existence of co-dependencies amongst informal and formal institutions (Spenser and Gomez, 2004) on entrepreneurialism in the UK farm sector. Therefore, any study that relies only on one type of institution will be making significant

prediction mistakes. The study clarified the distinct role played by formal and informal institutions on farmers' investment intentions. The study showed that informal institutions and not formal regulatory factors have a direct effect on farmers' intentions to invest in RE enterprises. This investigation found evidence that social acceptability of entrepreneurship in the RE sector was negatively related to investment intentions and that the degree to which society views entrepreneurship positively or negatively affects the efficacy of formal government policies. This research showed that a decrease in social acceptability of entrepreneurship in the RE sector would lead to lower investment intentions despite the availability of government policy support for RE given the existence of interaction effects between regulatory and normative institutions on entrepreneurial intentions.

This study provided further support for cognitive based process models of intentions by showing strong significant positive effects of perceived self-efficacy and perceived desirability of RE enterprises on investment intentions. The study demonstrated that the rich set of exogenous variables employed in this study only influenced investment intentions through their effect on perceived efficacy and perceived desirability of RE enterprises as posited by past research (Shapero and Sokol, 1982, Krueger, 1993, Krueger *et al.* 2000, Azjen, 1991, Bandura, 1977, 1986, 1999). An important contribution of this study was to demonstrate that perceived self-efficacy and perceived desirability were independent constructs (Shapero and Sokol, 1982, Shapero, 1984) and influenced investment intentions sequentially as opposed to simultaneously as argued in past research (Fitzsimmons and Douglas, 2010, Krueger, 1993). However, in support of Fitzsimmons and Douglas (2010), the study revealed that levels of perceived self-efficacy and desirability do not all have to be high for intentions to form.

The study highlighted the need for policy makers to focus on improving the cognitive and normative institutional environments as a way to improve levels of interest in RE

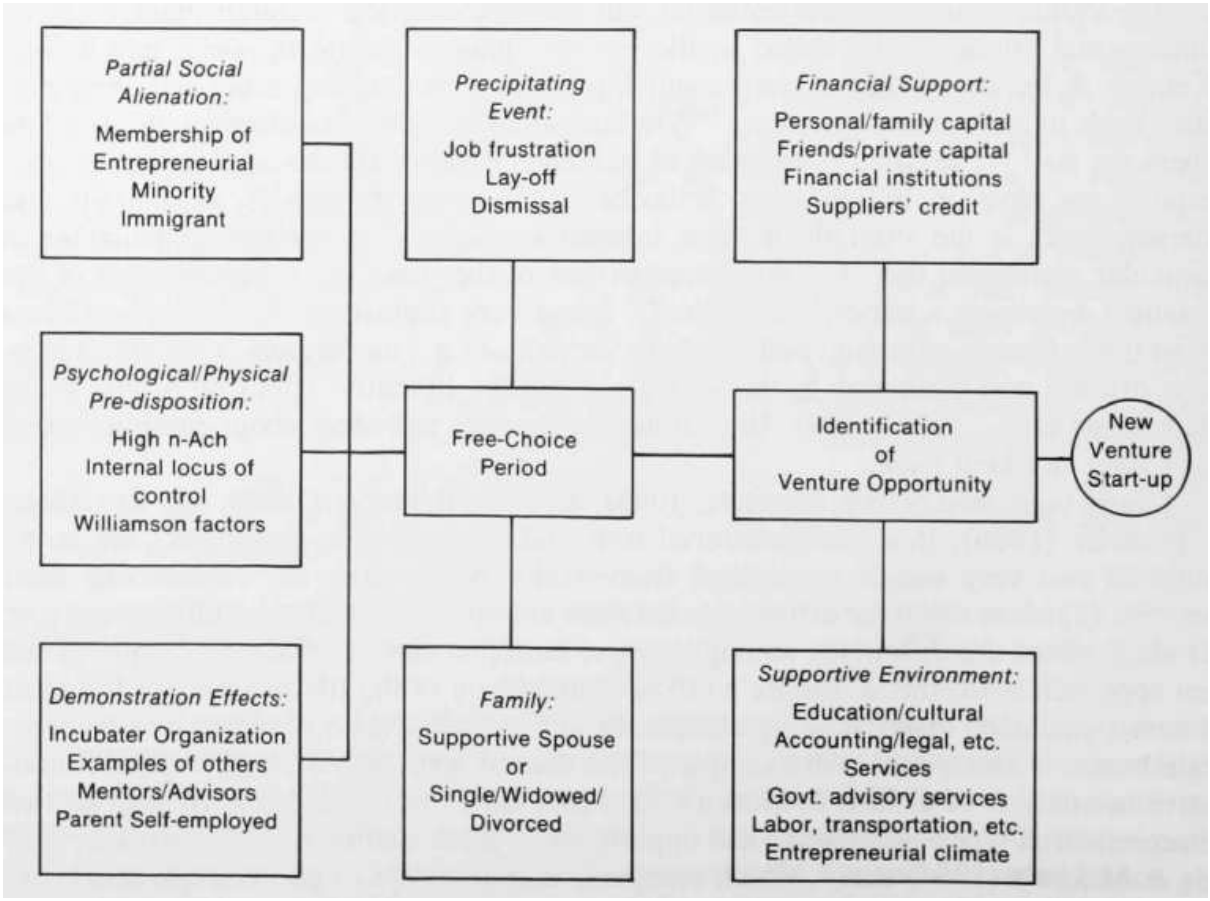
enterprises. It also showed that government policy effect on investment intentions happens through impact on perceptions of self-efficacy and perceptions of desirability of the enterprises. This study argued further that government's role should be to facilitate the identification of market opportunities and access to skills and resources required for investment.

For researchers, a robust intentions model was proposed which can be used to further entrepreneurship research in the farm sector. By finding that cognitive and normative institutions are the most important environmental factors affecting individual investment intentions, this study suggests that researchers should not only focus on formal RE policy but also integrate the effects of the cognitive and normative factors. Researchers need to increasingly integrate the investor's perspective when analysing the policy framework for RE development as this investigation showed that farmers' viewed the regulatory and cognitive institutional environments to be generally unfavourable for RE development in the UK. Such a view can ensure that government policies are targeted towards improving areas of weakness as identified "bottom up" rather than "top down". By using this approach, this study revealed mismatches between types of RE enterprises of interest to potential investors and the priorities set out in the government's RE road map (DECC, 2011b) and the 2012 UK Biomass Strategy (DECC/DFT/DEFRA, 2012).

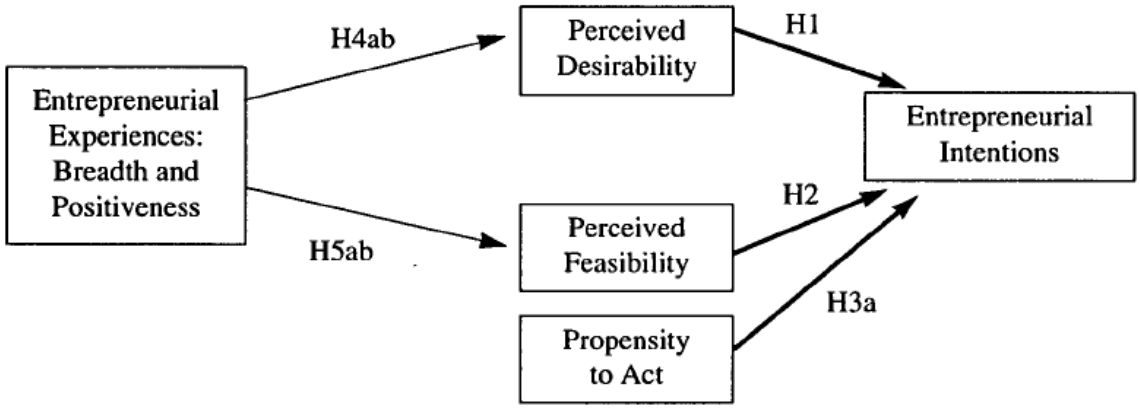
Appendices

Appendix 1

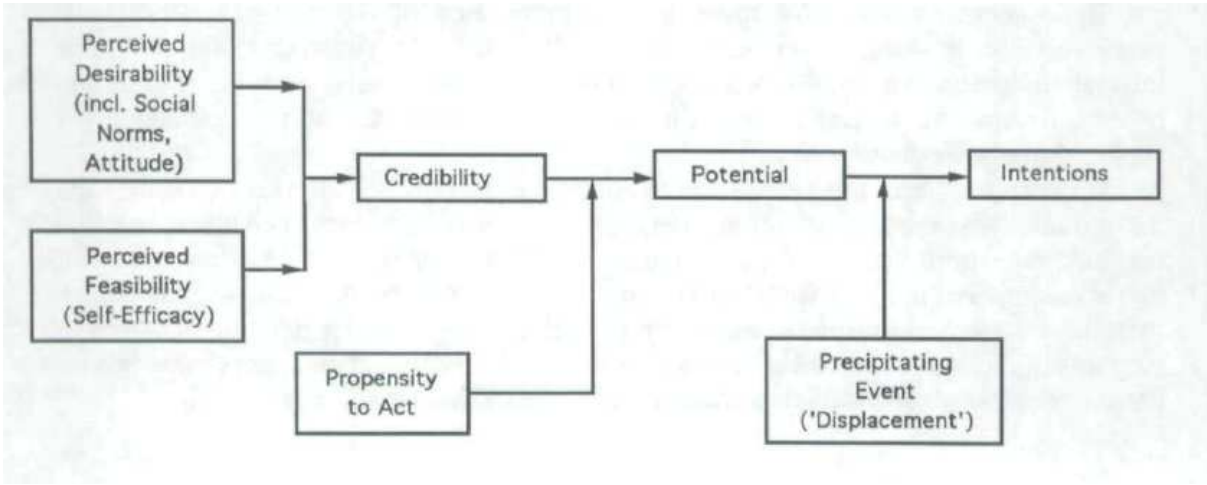
Models of new venture initiation



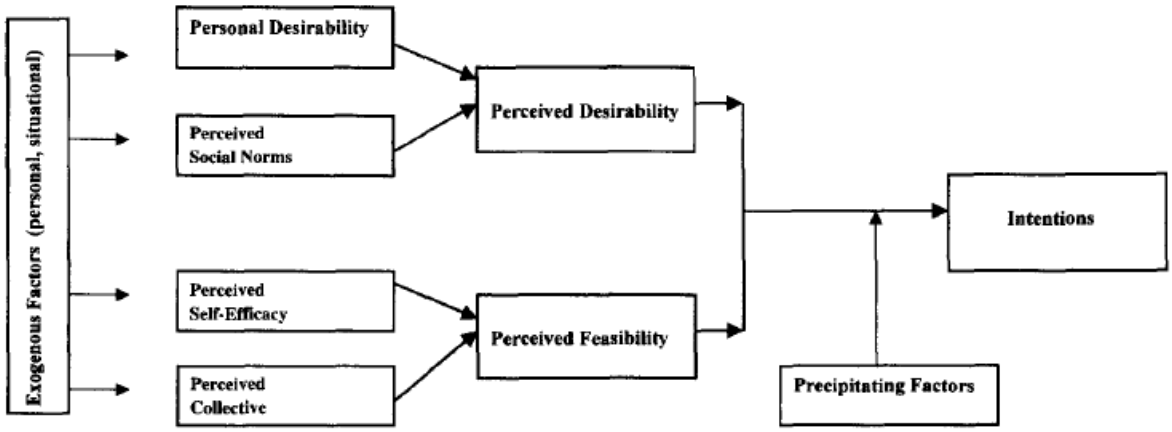
Source: Gartner, 1989 p.30



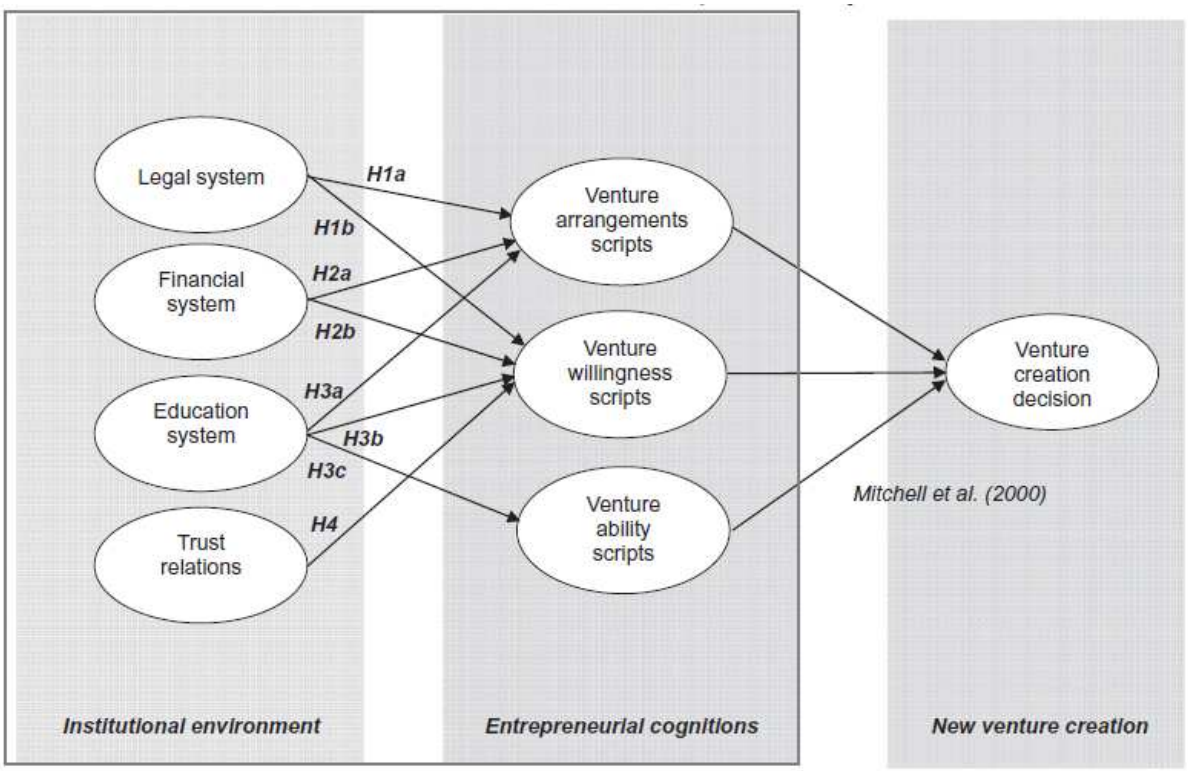
Krueger, 1993, pp.7



Krueger and Brazeal, 1994, p.95



Krueger et al., 2000, p 9



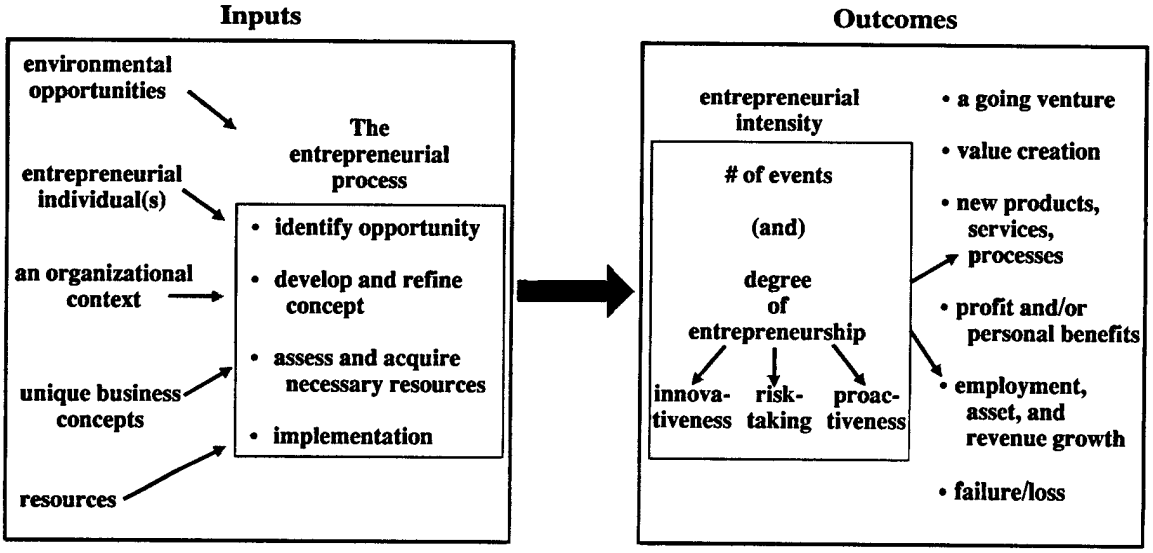
Lim et al., 2010, p.495

Seven Perspectives on the Nature of Entrepreneurship

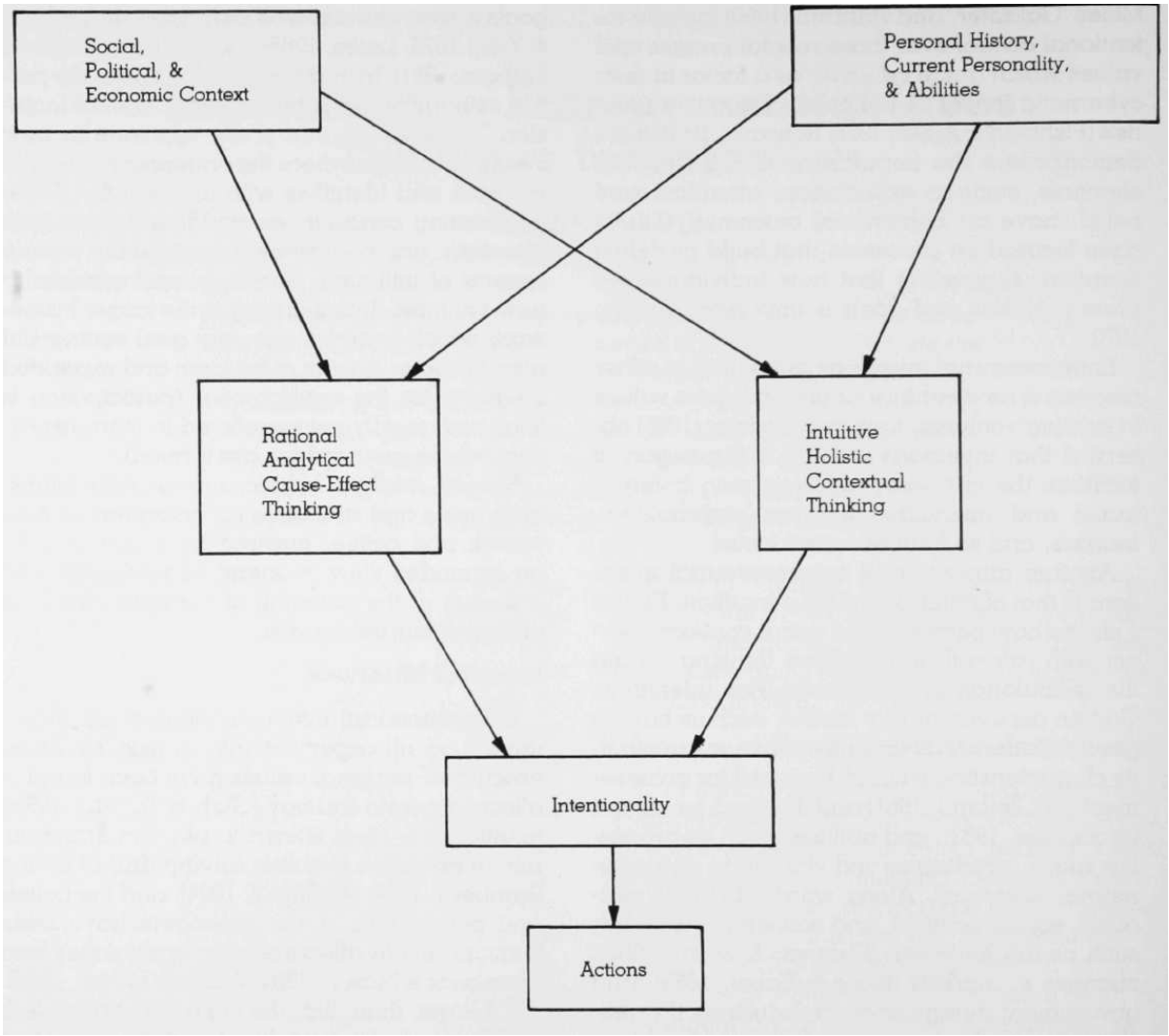
Creation of Wealth	Entrepreneurship involves assuming the risks associated with the facilitation of production in exchange for profit.
Creation of Enterprise	Entrepreneurship entails the founding of a new business venture where none existed before.
Creation of Innovation	Entrepreneurship is concerned with unique combinations of resources that make existing methods or products obsolete.
Creation of Change	Entrepreneurship involves creating change by adjusting, adapting, and modifying one's personal repertoire, approaches, and skills to meet different opportunities available in the environment.
Creation of Employment	Entrepreneurship is concerned with employing, managing, and developing the factors of production, including the labor force.
Creation of Value	Entrepreneurship is a process of creating value for customers by exploiting untapped opportunities.
Creation of Growth	Entrepreneurship is defined as a strong and positive orientation towards growth in sales, income, assets, and employment.

Morris et al., 1994 p.22

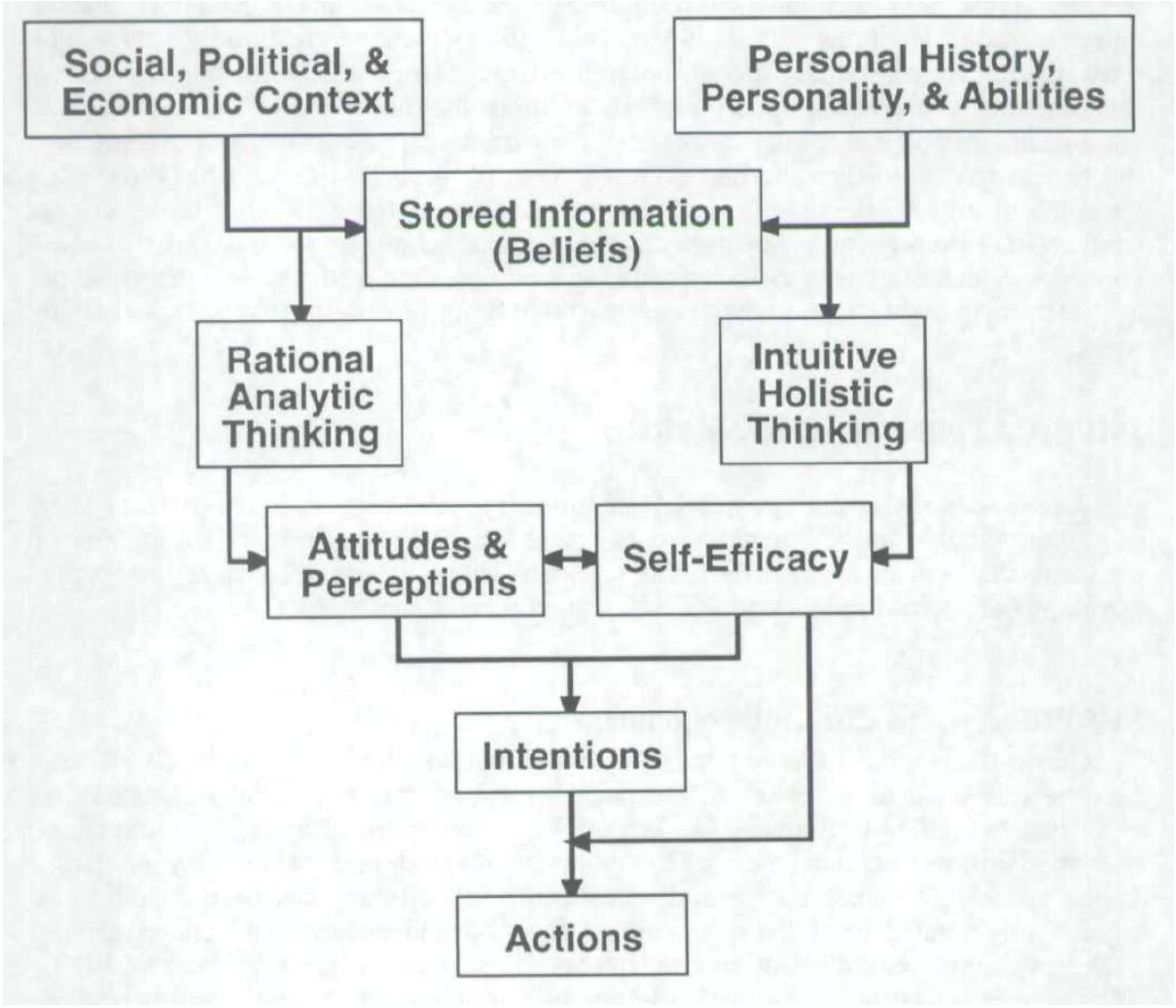
Input output model



Morris et al., 1994 p.22



Bird (1988)



Boyd and Vozikis (1994) p 69

Appendix 2: Pilot survey

This phase of the study was mainly concerned with understanding and exploring issues related to factors effecting attitudes and behaviours towards RE, it was not necessary for the sample to be representative of the whole population. The key issue was to obtain field information backup by extant literature in order to develop a sound postal survey instrument for the quantitative phase of the study. An attempt was made to interview farmers at different levels of interest on the subject. Additionally, an effort was made to include a wide range of farm types across the five regions of the west midlands.

7 farmers took part in the pilot survey. This group was purposefully defined to include current adopters, farmers who were weighing up adoption of RE, farmers with past experience of RE on farms and farmers who were not interested in the enterprises. The list of farmers was obtained from referents at the University of Wolverhampton and Yell.com. Farmers were contacted by telephone and email (for those with an email contact) to invite them to participate in the pilot. In the first instance the student introduced himself, the objectives of the study, how the farmer's contact details had been obtained and whether the farmer would be interested to discuss his/her views on the subject. 4 out of the 6 farmers suggested by referents at the University of Wolverhampton accepted to take part in the survey. A random list of 16 farmers was generated from Yell.com and only 3 farmers accepted to take part in the pilot survey. Once a farmer accepted to take part, an appointment was negotiated to fit with the activities of the farmer.

Interviews took place between June and September 2010. Discussions with farmers lasted between 1-2 hours and in most cases were followed by a general introduction of the farm. At the beginning of each interview, the objective of the study/visit was restated, confidentiality issues were cleared and the farmer was informed that the information

collected was for the sole purpose of the doctoral studies. The farmer was also informed that notes will be taken during the interviews. The interviews were conducted based on a checklist of predefined questions but these were only meant to serve only as guideline as the farmer was allowed to discuss whatever issue he/she found important. Most times the interview started with a general discussion of the evolution of the farm in the past five years, changes in the farm and the outlook for the farm business. After that discussions dwelled on the farmers assessment of the subject of RE, experiences with RE, attitudes/motivations to adopt bioenergy (or not), barriers (actual /perceived) and proposals to improve bioenergy deployment in the UK.

It was observed that current adopters involved in the study tended to be less than 50 years of age and reported higher levels of educational attainment. Additionally, they were more likely to report a portfolio of additional business activities and had also expanded the farm sizes in the past five years. Those adopting the RE most often stated that they had farm sizes above 300 ha and were involved in mixed, arable and specialist farms (pig). Interestingly, for these set of farmers, agriculture contributed less than half of household incomes. 2 out of the three adopters interviewed operated the farms as a family partnership while the third operated under limited company status. Looking at current non-adopters, it was found that farm sizes tended to be below 300 ha, agriculture represented a larger share of household incomes and they tended to be older operating mono-active or diversified farms. Most non-adopters operated arable crop farms and cropped on mainly owned lands.

All the seven farmers were familiar with RE technologies. Interestingly there appeared to be different attitudes and motivations regarding the pertinence and usefulness of these enterprises. Adopters or those interested were more likely to talk about these enterprises in terms of opportunities and or challenges while there was more accent on risk/barriers by

non-adopters. Taking those interested in these enterprises, the following points were highlighted:

1. Take advantage of government grants and incentives
2. Improve business performance
3. Reduce energy bills
4. Sell green – legitimacy
5. Access to banks – adopters or those interested where more likely to suggest that the banding of RE technologies would enable them access bank credits. They considered that the prospects of higher ROCs (renewable obligation certificates) would provide more collateral guarantees for banks.

Those with positive attitudes/motivations were more likely to report that they knew other successful farmers operating RE enterprises. They also suggested that the availability of farm resources had facilitated the implementation of the enterprises or was a positive influence on their intentions. Moreso, they portrayed better understanding of the regulations and were comfortable with their abilities to access paid advice and consultants. Worthy of note is also the contribution of family to the investment process. Many were keen to report that family had been supoortive and had been involved at some stage. This was either collecting information, filling grant application forms, recruiting consultants etc.

Looking at non-adopters, key issues raised related to risks and barriers involved. Even though adopters viewed the issues mainly as challenges they could overcome, a major difference that emerged was the fact that current non-adopters dwelled alot on social/normative barriers to invest. The were more likely to raise questions of public opposition, NIMBYISM and society's perceptions of these enterprises.

Another issue that was raised concerning the suitability of the farm was the absence of livestock which meant that anaerobic digestion would not be considered in any case.

1. Frequent changes in government regulation and risky market
2. Overdependence on power plants – underdeveloped markets
3. Would only invest of viable and concerns about returns on capital
4. Inadequate funds to invest
5. High investment costs
6. Increasing food prices
7. Low energy bills
8. Planning complications
9. Less sure about technologies, more likely to indicate that technologies are immature and not adapted

The issue of bad experience was raised by 2 farmers. These farmers had experience with the defunct bioenergy companies and were keen to argue that it was the case because of the underdeveloped market. They argued that over dependence on a few power plants that were often distant from their farms was going to limit interest particularly on energy crops. Other non- adopters also stated that the location of the farm (distant from the grid) was a key disincentive including perceived costs of linking up to the grid.

A few general issues also emerged from the discussions with the seven farmers relating the RE enterprises.

1. Possibility of cashflow disruptions during the early years of the enterprises
2. Long payback periods
3. RE according to some would reduce business flexibility
4. Dependence on power plants reduced margins for manoeuver
5. Increasing food prices would take away interest

6. Inadequate skills and techniques
7. Traffic - transport of crops to power plants was not seen to be easily acceptable by communities
8. Dependence on government subsidies was considered undesirable in the long term and
9. Decision making was strongly influenced by referents including family, friends and membership networks.

One implication for the second phase of the study therefore was to define and develop a research instrument that was sensitive to the issues raised by the farmers but also concerns that were not raised by the farmers.

Appendix 3: Questionnaire

With the assistance of

The Voice of British Farming

RESEARCH TITLE:
RE AND THE FARMER: A VIABLE BUSINESS PROPOSITION?

Introduction:

Faced with the challenge of climate change, RE could be an important option to mitigate climate change and it may also prove to be a profitable farm business diversification. We'd like to learn more about the reasons why farmers find adoption of these technologies challenging.

Only a small proportion of the NFU membership has been randomly selected to participate, so your experiences and thoughts on the subject are very important. Please help us by answering the questions to the best of your ability. As an incentive, we will offer Marks and Spenser (M&S) **vouchers worth fifty (£50) pounds** each to three farmers returning their completed questionnaires by **March 14, 2011**.

The results of the study will document the factors which help or hinder uptake of renewable technologies by farmers in the West Midlands. It will also help us to understand the motivations behind the decision to invest (or not) in renewable.

The questionnaire should take about 25 minutes to complete. We are aware that Spring is fast approaching and you should be getting very busy. We hope you could find time within your very busy schedule to help complete it. Please kindly return the completed questionnaire to me by March 14, 2011 in the enclosed freepost envelope.

If you have any questions or would like further information, please do not hesitate to telephone me on 01902323863 or email me at a.mbzibain@wlv.ac.uk. **I am grateful for your kindness, and thank you for your generous help in completing this questionnaire to help me with my postgraduate research.**

(1) Please tick here to indicate that you have understood the purpose of this study ☐

(2) Please tick here to indicate that your participation in this study is completely voluntary ☐

(3) If you would love to take part in the draw to win a £50 M&S voucher, please tick here ☐

(4) If you would like to receive a summary of the research findings please provide me an email address:

_____

SECTION 1: RE (RE) REGULATIONS AND POLICIES

For each of the following statements, **please tick ✓ the box** that matches your view most closely.

	Strongly disagree		Unsure	Strongly agree
1.1 Government and council support				
Government organisations assist farmers to start RE enterprises	❑1	❑2	❑3	❑4❑5
Government sponsors organisations that help farmers invest in RE	❑1	❑2	❑3	❑4❑5
Current policies encourage farmers to adopt RE on their farms……	❑1	❑2	❑3	❑4❑5
Councils provide support for farmers who want to set up RE on farms…..❑1		❑2	❑3	❑4❑5
Government grants are accessible for farmers starting RE enterprises……❑1		❑2	❑3	❑4❑5
Banks have funds available for farmers for starting RE enterprises……❑1		❑2	❑3	❑4❑5
1.2 Procedures to set up RE enterprises				
Farmers have to comply with too many procedure requirements…….. ❑1		❑2	❑3	❑4❑5
Procedures for grid connection **discourage** farmers from generating RE… ❑1		❑2	❑3	❑4❑5
Local council planning procedures **discourage** farmers to invest in RE……. ❑1		❑2	❑3	❑4❑5

SECTION 2: STANDING OF ENTREPRENEURS, PUBLIC PERCEPTION AND SOCIAL NORMS

For each of the following statements, **please tick ✓ the box** that matches your view most closely.

	Strongly disagree		Unsure	Strongly agree
2.1 Standing of entrepreneurs/ public perception				
People in the UK tend to admire those who start their own businesses..❑1		❑2	❑3	❑4❑5
Farmers with successful businesses are admired ……❑1		❑2	❑3	❑4❑5
People in the UK care a great deal about climate change ……..❑1		❑2	❑3	❑4❑5
2.2 Social norms				
Because of climate change, investing in RE is a moral obligation	❑1	❑2	❑3	❑4❑5
Most people that I look up to for advice think it is good to invest in RE…..❑1		❑2	❑3	❑4❑5

SECTION 3: PUBLIC AWARENESS, INFORMATION AND TRAINING PROGRAMMES

For each of the following statements, **please tick ✓ the box** that matches your view most closely.

	Strongly disagree		Unsure	Strongly Agree
3.1 Public awareness, information and training				
Most farmers know where to find relevant information about RE	❑1	❑2	❑3	❑4❑5
Farmers are familiar with the government financial support mechanisms/packages available to them…….	❑1	❑2	❑3	❑4❑5
There many training programmes for farmers on RE topics….	❑1	❑2	❑3	❑4❑5
People know a great deal about RE ……	❑1	❑2	❑3	❑4❑5

SECTION 4: PERCEPTIONS ON RE BUSINESS OPPORTUNITIES

For each of the following statements, **please tick ✓ the box** that matches your view most closely.

	Strongly disagree		Unsure	Strongly agree
4.1 Your perceptions on RE business opportunities				
a) There are new market opportunities in RE if I want to exploit them.	❑1	❑2	❑3	❑4❑5

b) RE can help improve the economic success of my business.. ❑1 ❑2 ❑3 ❑4❑5

c)RE production is not a viable option compared to

my existing farm business activities…… ❑1 ❑2 ❑3 ❑4❑5

d) If I start a RE enterprise it will help me achieve other important

non-economic goals in my life…… ❑1 ❑2 ❑3 ❑4❑5

SECTION 5: INTENTION AND DECISION-MAKING

For each of the following questions, please **tick** ✓the box that matches your view most closely.

5.1 (a) Have you already adopted any form of RE enterprise on your farm?

Yes……. ❑1 No…….. ❑2 ➔**IF NO, PLEASE SKIP TO QUESTION 5.2 ON THE NEXT PAGE**

b) If yes, when did you set it up? (*Please write the year*) _____

c) What was the source of funding for this project? Please **tick** ✓**all** the appropriate boxes.

Bank ❑ 1 Government grant/subsidy ❑2 Personal Savings❑3 Business ❑4

Other_____

d) Kindly indicate which type (s) of RE enterprise (s) you have adopted? *(You can tick more than one)*

Miscanthus……. ❑1 Short rotation coppice.. ❑2 Combine heat power…… ❑3

Wind turbine…..❑4 Anaerobic digesters……. ❑5 Pellet production…. ❑6

Biomass boiler.. ❑7 Solar……..❑8 Other ……❑9

e) To what extent has the adoption of the enterprise contributed to your farm business performance?

Highly deteriorated	Deteriorated	Remained the same	Slightly Improved	Significantly improved
❑1	❑2	❑3	❑4	❑5

f) In comparison to your conventional farming activities, what proportion of your total farm income was derived from the RE enterprise (s) in 2009 (IF AT ALL)? _____ %

g) Can you kindly indicate the level of contribution of the RE enterprise to your total farm income in 2009?

Not sure..❑1 £ 0 ❑2 £1- £10 000…❑3 £10000 - £25000…❑4 > £25 000…❑5

h) How likely is it that you will expand the RE enterprise (s) on your farm in the next 5 years? Very unlikely

❑1 Unlikely ❑2 Undecided ❑3 Likely ❑4 Very likely ❑5

➔ **PLEASE NOW SKIP TO QUESTION 5.3 ON THE NEXT PAGE**

5.2(a) How interested are you in setting up some form of RE enterprise on your farm?

Very uninterested ❑1 Uninterested ❑2 Undecided ❑3 Interested ❑4 Very interested ❑5

b) How much consideration have you given to establishing a RE enterprise on your farm?

None whatsoever ❑1 Have thought about it ❑2 Considered but undecided ❑3

Considered and interested ❑4 Considering implementation ❑5

c) How likely is it that you will set up some form of RE enterprise on your farm within the **next five (5) years?**

Very unlikely ❑1 Unlikely ❑2 Undecided ❑3 Likely ❑4 Very likely ❑5

d) Which enterprise are you most likely to adopt **first**? IF AT ALL *(Please kindly tick **only one** box)*

Miscanthus…….	❑1	Short rotation coppice	❑2	Combine heat power……	❑3
Wind turbine….	❑4	Anaerobic digesters…….	❑5	Pellet production…….	❑6
Biomass boiler	❑7	Solar……..❑8		Other……..	❑9

➔**PLEASE GO TO 5.4 IF YOU DO NOT INTEND TO ADOPT ANY RE ENTERPRISE IN THE FUTURE**

5.3 Please kindly **rank 4 items** in order of importance to you as regards why you would adopt (or why you adopted) the RE enterprise mentioned on your farm. Number the most important 1, the next important 2 and so on.

To take advantage of grants/subsidies…	❑	To dispose of farm waste……..❑	
To diversify farm income……..	❑	To cut farm business costs……❑	
To help meet government energy targets…	❑	To provide environmental benefits……❑	
To take advantage of market opportunities	❑	Other (please specify)_____	

5.4 If you do not intend to invest in any form of RE enterprise in the near future, please **kindly write** in order of importance, **3 most** important reasons for not doing so. Where 1 = most important, the next important 2, …

1) _____

2) _____

3 _____

SECTION 6: YOUR ABILITIES, RESOURCES and FARM BUSINESS MOTIVATIONS

For each of the following statements, **please tick** ✓ the box that matches your view most closely.

6.1 How much confidence do you have in your ability to…?

Abilities	Very little				Very High
a) Identify new business opportunities and act on them……	❑1	❑2	❑3	❑4	❑5
b) Find the right technology that is needed for the farm……	❑1	❑2	❑3	❑4	❑5
c) Estimate financial viability of a RE enterprise	❑1	❑2	❑3	❑4	❑5
d) Raise enough funds to start a RE enterprise	❑1	❑2	❑3	❑4	❑5
e) Lead the planning permission process at local council level.	❑1	❑2	❑3	❑4	❑5
f) Organise and maintain financial records of your farm business	❑1	❑2	❑3	❑4	❑5

6.2 To what extent do you agree or disagree with the following statements about your business networks?

Support of friends and business networks	Strongly disagree	Unsure	⇨ agree		⇨ strongly
My family has social relationships that can help my business……	❑1	❑2	❑3	❑4	❑5
I have friends and family that can assist my business development……	❑1	❑2	❑3	❑4	❑5
I have business networks that I can rely on in case of difficulties……	❑1	❑2	❑3	❑4	❑5
The knowledge that is necessary to exploit potential opportunities in RE is very similar to the knowledge that you already possess……	❑1	❑2	❑3	❑4	❑5

SECTION 7: FARM BUSINESS CHARACTERISTICS

Please kindly **tick** ✓ the boxes that apply in the following questions.

7.1 Predominant farm type

Cereals ……❑1
General cropping……..…. ❑2
Horticulture…… ❑3
Speciality Pigs…… ❑4
Speciality poultry…… ❑5
Grazing livestock (LFA) …… ❑6
Grazing livestock (lowland) …... ❑7
Dairy…… ❑8
Mixed …….. ❑9
Other (please specify) _____

7.2 Total farm area (ha)

Under 5 ha…….❑1
5 – 20 ha……❑2
20 – 50 ha…… ❑3
50 - 100 ha……❑4
100 and above…. ❑5

7.3 Structure of the farm business

Sole proprietorship…….. ❑1
Family partnerships…… .❑2
Partnership with nonfamily……..❑3
Limited Company……❑4
Co-operative……..❑5
Other (specify)…… ❑6

7.4 Tenure

Wholly tenanted…… ❑1
Mainly tenanted…… ❑2
Mainly owned…….. ❑3
Wholly owned……..❑4

7.5 Annual value of total sales of agricultural products in 2009

Under £50 000……..❑1
£50 000 - £99 999……..❑2
£100 000 - £499 999…… ❑3
£500 000 and over…….❑4

7.6 Share of family income from agriculture in 2009

Under 25%.....❑1
25 – 49%.....❑2
50 – 74%.....❑3
75% and over…… ❑4

7.7 Farm made a loss or a profit over past 5 years?

Significant profit…… ❑1
Moderate profit…… ❑2
Break even …… ❑3
Moderate loss…… ❑4
Significant loss …… ❑5

7.***8New activities within the farm in the past five years***

Please **tick ✓each (a - f)** of the following statements

	Yes	***No***
(a) Energy crops/ RE……	❑1	❑2
(b) Accommodation or catering……	❑1	❑2
(c) Agricultural contracting……	❑1	❑2
(d) Non-agricultural contracting	❑1	❑2
(e) Food preparation and packaging	❑1	❑2

(f) Others (please specify) _____

7.9 In comparison to your conventional farming activities, what proportion of your total income was derived from these other activities within the farm in 2009? _____ %

7.10 Do you have/manage any other additional businesses out of agriculture? (Please write number)_____

7.11 In comparison to your conventional farming activities, what proportion of your total income was derived from these other business activities out of agriculture in 2009? _____ %

SECTION 8: FARMER CHARACTERISTICS

Please **tick** ✓ the appropriate boxes in the following questions.

8.1 Are you male or female? Male ❑1 Female ❑2

8.2 Please indicate your age

Less than 35…… ❑1
35 – 44 years ……❑2
45 – 54 years …….. ❑3
55 – 64 years …….. ❑4
65 years and over…….. ❑5

8.3 Years of experience in agriculture

Under 5 years…… ❑1
5 – 14 years…….. ❑2
15 – 24 years…….. ❑3
25 years and over…….. ❑4

8.4 Education attainment

Below secondary……❑1
Secondary……❑2
University degree……..❑3
Postgraduate degree……..❑4
Not undertaken formal study❑5

8.5 Have you undergone training in any of these areas?

Agriculture…… ❑1
Management…….…… ❑2
Finance…….. ❑3
Marketing…… ❑4
Other subject _____

Thank you very much for your time and help.

Now please kindly return the completed questionnaire to me by March 14, 2011 in the enclosed envelope to:

Aurelian Mbzibain
University of Wolverhampton Business School
City Campus North, Room MN005, Nursery Street
Wolverhampton. WV1 1AD

Appendix 4: Cover letter and reminder letter

UNIVERSITY OF WOLVERHAMPTON BUSINESS SCHOOL **With the assistance of** NFU The Voice of British Farming

Date: 23 February, 2011

RE AND THE FARMER: A VIABLE BUSINESS PROPOSITION?

Faced with the challenge of climate change, RE could be an important option to mitigate climate change and it may also prove to be a profitable farm business diversification. We'd like to learn more about the reasons why farmers find adoption of RE enterprises challenging.

This questionnaire is part of my PhD research project undertaken at the University of Wolverhampton with the assistance of the National Farmers' Union to understand the viability of RE enterprises in the UK farm sector. Only a small proportion of the NFU membership has been randomly selected to participate, so we very much count on your experiences and thoughts on this topical subject. The questionnaire should take about 25 minutes to complete. We are aware that Spring is fast approaching and you should be getting very busy. We hope you could find time within your very busy schedule to help complete it.

The results of the study will document the factors which help or hinder uptake of renewable technologies by farmers in the West Midlands. It will also help us to understand the motivations behind the decision to invest (or not) in renewables. As a modest incentive we will be offering three (3) £50 M&S vouchers to three farmers returning their completed questionnaires by March 14, 2011.

The information you provide will be treated in the strictest confidence. Your personal information will not appear anywhere in any publication. Also all data collected as part of this research will be stored in a locked cabinet within University of Wolverhampton and will be shredded after five years.

Please return the completed questionnaire to Aurelian Mbzibain, by **March 14, 2011** in the enclosed self addressed envelope. If you have any questions or would like further information, please do not hesitate to telephone Aurelian on 01902 323 863 or Sarah on 01952 409 247.We are grateful for your kindness, and thank you for your generous help in completing this questionnaire to help with this postgraduate research.

Sincerely,

Aurelian Mbzibain
PhD Student, UWBS

Sarah Faulkner
Policy Adviser (Environment), NFU

University of Wolverhampton
Nursery Street, City Campus North
Wolverhampton WV1 1AD
UK
T. +44 (0)1902 3213863
F. +44 (0)19020321701

with the assistance of

The Voice of British Farming

Date: March 15, 2011

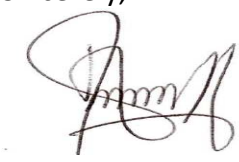
Reminder: RE AND THE FARMER: A VIABLE BUSINESS PROPOSITION?

About three weeks ago we sent you a questionnaire on the subject: **RE and the farmer: a viable business proposition?** Your name was randomly selected from a list of about 6000 farmers from the West Midlands National Farmers' Union database.

If you have already returned the questionnaire, please accept our sincere thanks. If not, please do it today. Because it was sent only to a small number of farmers in the West Midlands, we very much need **your help** if the results of this questionnaire are to accurately represent the opinions and experiences of other farmers in the West Midlands and the UK more generally. As an incentive, we will offer an additional Mark and Spenser (M&S) **voucher worth fifty (£50) pounds** to a farmer returning their completed questionnaires by March 31, 2011.

If you did not receive the questionnaire, or got it misplaced, please call me on 01902323863 or email me at: a.mbzibain@wlv.ac.uk and we will get another one in the mail to you immediately.

Sincerely,



Aurelian Mbzibain
PhD Student, UWBS
NFU

Sarah Faulkner
Environmental Advisor,

Appendix 5: Farm Business Survey 2010/2011 description of the West Midlands Region, UK

West Midlands Region Commentary 2010/2011

This report includes data collected from the Farm Business Survey for the 2010 to 2011 financial year, relating to the 2010 crop harvest.

The Farm Business Survey is conducted on behalf of, and financed by the Department for Environment, Food and Rural Affairs, and the data collected in it are Crown Copyright.

The West Midlands region

The West Midlands region, consists of the counties of Herefordshire, Shropshire, Staffordshire, Warwickshire and Worcestershire, and covers an area of 13,000 square km. It ranges from Stoke-on-Trent in the North East to Ross-on-Wye in the South and borders the Black Mountains of Wales in the West.

The region is home to 5.5 million people (9% of the GB total), more than half of whom live in large conurbations such as Wolverhampton, Coventry and Birmingham; the latter is the capital of the region and the second largest city in the UK, with a population of over 1 million. About 35% of the population live in rural areas, many of whom commute into the towns and cities to work.

The West Midlands was the birthplace of the Industrial Revolution and still has one of the highest proportions of manufacturing companies of any UK region, accounting for 11.8% of all people employed, a figure which has declined in recent years, with the service sector becoming more important. The region contributed 7.2% (£93.1 billion) of the UK's Gross Value Added (GVA) in 2010. Major local companies with headquarters in the West Midlands include Jaguar, Land Rover, Aston Martin, IMI PLC, Lucas, Tarmac, GKN, JCB and Wedgwood.

Table 1 – employment by industry sector in the West Midlands

	Employee Jobs	Proportion %
Agriculture, Forestry and Fishing	33,000	1.3
Mining, Energy and Water	32,000	1.2
Manufacturing	302,000	11.8
Construction	160,000	6.2
Distribution, Finance and Business Services	1,022,000	39.9
Education, health, public admin & other Services	680,000	26.5
Other	335,000	13.1

Source: Employment by industry sector in the West Midlands – accessed 9-12-11 http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-226766

There are 2,618,000 economically active and 1,720,000 economically inactive people in the Region.

The employment rate in agriculture and the related sectors is a little over one per cent [1.3%] of the total with over three quarters engaged in distribution, finance and business services and, education, health, public administration & other services.

During 2010 the unemployment rate in the West Midlands fell during the first half of the year from 9.2% in January to 8.4% in July. This decline, however, did not continue in the second half of the year as the rate increased throughout the remaining months to 9.7% in December, compared with a peak of 10.5% in May 2009. During the same period the UK unemployment rate fell from 8.0% at the beginning of the year to 7.8% in July 2010 before increasing to 7.9% in December, compared with the higher underlying unemployment trend in the West Midlands region.

Although at the heart of the nation's transport network, the West Midlands economy suffers a number of particular problems, including low life expectancy, below average levels of worker skills, and low worker productivity – GVA per head at £17,060 (2010), is only 82% of the UK average and this proportion has been falling in recent years. The rural west of the region contains some of the most remote and sparsely populated areas in England, with attendant problems relating to access to services and work.

About 80% of the region is rural and contains five Areas of Outstanding Natural Beauty (AONB)-Cannock Chase, Cotswolds, Malvern Hills, Shropshire Hills and Wye Valley. Part of the Peak District National Park (NP) is situated in the region, together with 19 Special Areas (SA) of conservation, plus 26,000 hectares of Sites of Special Scientific Interest (SSSI). However, these areas of AONB, NP, SA and SSSI are smaller than that of other regions in England.

Farming in the West Midlands Region

The 13,689 holdings in the region in 2010 covered 915,412 ha (70% of land in the region and 10.3% of the total agricultural area in England), with some 49% of this in an arable rotation, set aside/fallow, or leys and a further 45% under permanent grass. Around 9.3% of these farms were less than 5 ha, this being a lower figure than in previous years in line with Defra's June Survey reporting on commercial holdings with small part time non-commercial holdings excluded.

Farming in the West Midlands region is dominated by livestock, but there are also areas of intensive arable farming and horticulture. The region accounts for around 14.4% of the cattle and sheep in England, with the heaviest concentrations within the region in the rural west, and sheep production (accounting for 14.7% of the England total) dominating in the Black Mountains of Herefordshire and the moorlands of Staffordshire. Arable farming is

widespread, and includes 15.9% of the potato area in England. There are over 25,000 ha of horticulture crops (around 12% of the England total), predominantly in Herefordshire, the Vale of Evesham and the red sandstone areas of mid-Worcestershire. Around 47% of this area is vegetables and salads grown in the open and the remainder being, apples and protected fruit production, with a very small area of hops.

Agriculture contributed 0.87% of the region's GVA in 2009, (with 2009 being the most current data available), a figure which has remained relatively constant over the last five years, and provided 1.26% of regional employment (England average 1.51%). Agriculture in the West Midlands region accounted for 11.80% of the GVA for agriculture in England as a whole, down from 11.90% in 2005.

The 2010/11 FBS year in the West Midlands region

Weather

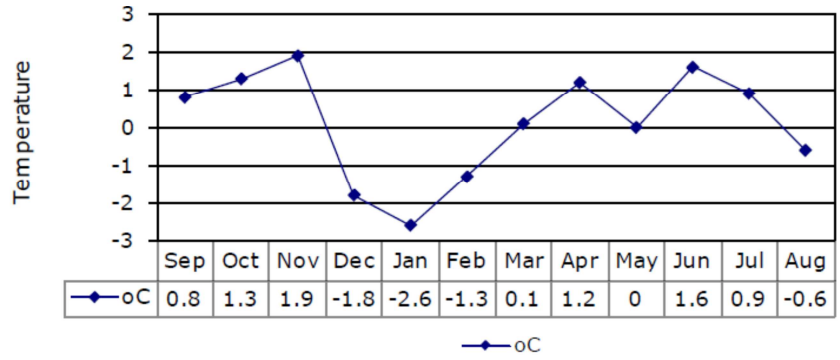
The autumn of 2009 was mild and dry which led to good conditions at the time of drilling. November proved to be a very wet month with rainfall 92% higher than normal – in contrast to the region seeing just 34% and 77% of average rainfall in September and October respectively. Sunshine hours throughout the autumn did not deviate far from the norm with September and November seeing just over the seasonal average, +4% and +8%, while October saw cloudier conditions. November proved to be the warmest recorded since 1994 and the second wettest since 1914.

The winter months of December 2009 through to February 2010 proved to be considerably colder, sunnier and drier than the seasonal averages. Temperatures in December were 1.8°c lower than the seasonal average while January was 2.6°c degrees lower and February was 1.3°c lower. December through to February had 5, 7 and 4 more days with air frost than normal and in fact was the coldest winter recorded since 1995. January continued the cold theme with the month being the coldest since 1987. In comparison to the regional averages the winter was sunnier than normal and December and January received 54% and 29% more sun than average in line with the high pressure which was causing the cold weather. Rainfall in January and February was 11% and 19% lower than average.

Spring 2010 was warmer sunnier and drier than average. April and May were particularly dry months with less than 80%, 43% and 57% of average rainfall seen in April, May and June; April to June was also particularly sunny with sunshine hours 33%, 40% and 8% higher than average. April was the fifth sunniest on record in a data series going back to 1929.

The summer months of 2010 proved a challenge for farmers of most farm types. The drought conditions seen in the spring continued into the early summer. The mean temperature recorded in June was 1.6°c warmer than average and the region saw just 65% of the average rainfall. Sunshine hours during June were 37% above average. July proved to be a mixed month with a drier first half followed by showery conditions in the second half of the month, which made harvest difficult. August followed the trend seen in July with below average temperatures, low sunlight and 151% of the average rainfall.

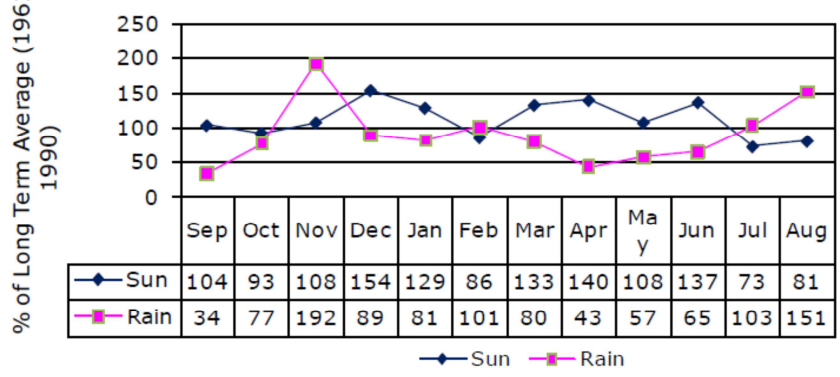
Figure 1. Temperature (°C) Anomalies - 2010 Growing Season (Source: Met Office)



	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
oC	0.8	1.3	1.9	-1.8	-2.6	-1.3	0.1	1.2	0	1.6	0.9	-0.6

Source http://www.metoffice.gov.uk/climate/uk/2009/
http://www.metoffice.gov.uk/climate/uk/2010/

Figure 2. Sunshine and Rainfall Anomalies - 2010 Growing Season (Source: Met Office)



	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Sun	104	93	108	154	129	86	133	140	108	137	73	81
Rain	34	77	192	89	81	101	80	43	57	65	103	151

Source http://www.metoffice.gov.uk/climate/uk/2009/
http://www.metoffice.gov.uk/climate/uk/2010/

Economic Background

Prices of agricultural commodities rose in 2010 following a decrease in 2009. Of particular note were significant increases in the producer prices for cereals and forage crops. The producer prices for fresh vegetables and flowers and plants also increased markedly. Producer prices for livestock were similar to the previous year with the livestock products of milk and wool increasing by 4% and 50% respectively, whilst egg prices were down almost 5%. General inflation, as measured by the Consumer Price Index (CPI), rose from 2.9% in December 2009 to 3.7 in December 2010, with the main contributing factors being increases in the price of food and beverages and for transport.

Table 2 - Producer prices for agricultural products (2005=100)

Crop Products	2006	2007	2008	2009	2010
Cereals	111.8	166.7	207.1	150.1	172.4
Industrial crops	98.7	112.0	159.9	139.1	146.8
Forage Crops	95.2	128.6	145.6	147.0	181.5
Fresh Vegetables	109.1	122.1	117.5	113.9	131.9
Potatoes	131.1	146.7	154.3	123.4	141.2
Fresh Fruit	104.1	107.4	126.4	124.6	129.6
Seeds	100.2	118.3	126.4	126.4	126.4
Flowers & Plants	103.4	110.1	115.1	116.7	138.2
Other Crop Products	100.5	113.3	119.4	119.5	119.9
Livestock & livestock products					
Livestock for Slaughter & export	103.5	105.5	133.2	146.0	146.2
Milk	97.2	112.2	140.4	128.4	133.5
Eggs	104.0	118.3	140.4	144.7	137.8
Wool Clip	36.4	77.7	78.9	71.4	107.5

Source: DEFRA, Agri Price Index

Input prices rose again in 2010, with fixed costs rising at a faster rate than variable costs. Within variable costs there were both increases and reductions to the main items listed. Animal feedingstuffs, maintenance costs, veterinary costs and general expenses all increased while crop input costs for fertiliser, plant protection and seeds were down on the year before. Costs relating to agricultural investment increased in 2010, with those for machinery & equipment, vehicles, buildings and soil improvements increasing by 1.6%, 4.3%, 5.1% and 1.3% respectively.

Table 3 - Prices of agricultural inputs (2005=100)

	2006	2007	2008	2009	2010
Goods and services currently consumed in agriculture	100.0	103.7	115.2	145.5	136.5
Animal feedstuffs	104.6	129.7	167.3	152.5	160.8
Seeds	92.5	104.3	111.6	112.1	110.3
Fertilisers and soil improvers	105.7	119.8	272.5	189.8	182.4
Plant protection products	102.5	104.2	106.4	108.5	105.6
Maintenance and repair of plant	105.8	109.9	116.3	121.5	126.9
Energy and lubricants	112.2	117.9	158.2	130.4	147.1
Maintenance and repair of buildings	106.3	114.1	122.3	122.0	130.1
Veterinary services	106.9	108.4	104.0	104.7	118.8
Other goods & services (General expenses)	102.6	108.2	113.5	115.4	123.3
Contribution to agricultural investment					
Machinery and other equipment	104.5	110.3	117.5	122.1	124.0
Vans & Lorries	100.7	101.4	105.1	114.5	119.4
Buildings	105.9	113.0	120.3	120.6	126.7
Engineering & soil improvements	102.1	107.3	112.1	118.2	119.8

Source: DEFRA, Agri Price Index

A Defra review was carried out in 2009, in consultation with stakeholders to determine the best source of farm rents data. It concluded that the Farm Business Survey should become the main source of data and that the Tenanted Land Survey (the previous source of rent data) be discontinued. The latest source of data currently available is for 2009.

Average Full Agricultural Tenancies (FAT) rents in England remained relatively stable in 2009 at £140 per hectare following an increase of 5.1% in 2008. Rents for Farm Business Tenancies (FBT) also remained stable at the 2008 recorded value of £160 per hectare, following an increase of 5.4% in 2008. In the West Midlands rents paid for FAT increased by 3% while those paid for FBTs increased by 12%, significantly higher than the average of 1% for England. Rents paid for seasonal agreements decreased by 7% following a decrease of 8.5% in 2008.

Land values in the West Midlands increased on average by 13.6% in 2010 following a decrease in 2009 of 5.4% in 2009. The increases varied according to its main use with the lowest increase (+12.1%) for dairy while the largest increase noted was for mixed farms (+15.5%). The highest land values achieved in the West Midlands continued to be for arable land at £20,686 per hectare, £617 per hectare ahead of the values for dairy and mixed farms.

Environment

The West Midlands region supports significant proportions of the total England resource of a number of key semi-natural habitats, including:

- Lowland meadows (20%)
- Lowland acid grassland (10%)
- Broadleaved woodland (10%)
- Lowland heathland (9%)
- Parkland and wood pasture (9%)

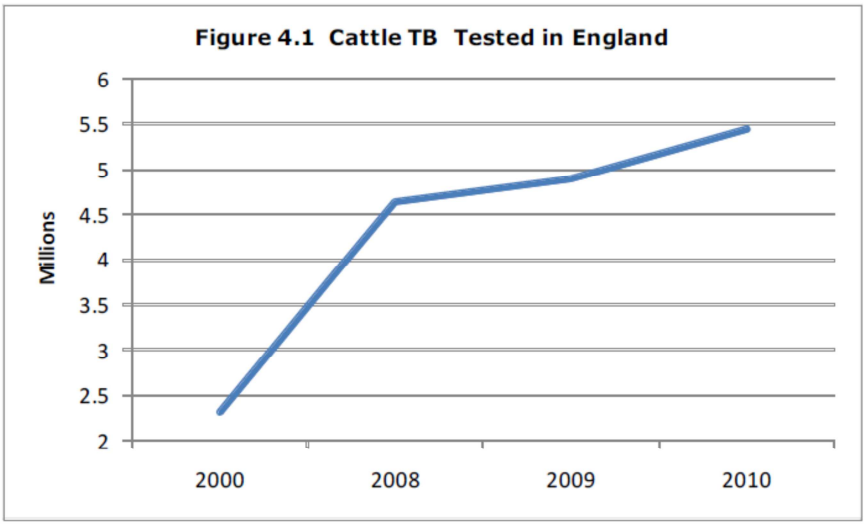
The region also hosts a number of internationally important rivers (the Severn, the Avon, and the Wye), as well as freshwater lakes, peatlands and upland grasslands and heaths. The Environmental Stewardship Scheme was launched in March 2005 to build upon the Environmentally Sensitive Areas (ESA) Scheme and the Countryside Stewardship Scheme (CSS). On 3 July 2006 Defra announced the addition of new management options for Environmental Stewardship. These were, for all tiers: (i) Maintenance of weatherproof traditional farm buildings; (ii) Mixed stocking (extended to LFAs); and for HLS only: (iii) Cattle grazing supplement; and (iv) Native breeds at risk grazing supplement.

Animal disease

Bovine TB is a continuous challenge for primarily the cattle industry but the pig industry is becoming increasingly concerned with the situation after 40 cases were identified in pigs during an 18-month period in 2009/10. The problem of bovine TB is most concentrated in the West Country, Wales, Gloucestershire, Worcestershire, Herefordshire and Shropshire. In December 2011 the government issued a press release noting that the devastating problems caused by bovine TB are to be tackled by a package of measures which include controlled culling of badgers as part of a science-led and carefully managed badger control policy. The policy is expected to be piloted initially in two areas in early autumn 2012.

In 2010 the numbers of cattle reactors in England slaughtered decreased to 24,213 from 24,500 in 2009. Since 2000, cattle testing in England (Figure 4.1) has risen from 2.31 million to 4.99 million annually, during which time testing in the West Midlands has risen three fold, from just over 388,000 to 1.18 million cattle, which represents a quarter of all testing in England.

Figure 4.1 Cattle TB Tested in England



Source:
http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/stats/documents/10/2010west.pdf
http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/tb/stats/documents/10/2010north.pdf

FBS results by farm type

Please note that the classification of farms has been revised this year meaning that these results are not directly comparable with those published in earlier statistical notices. Please see the explanatory document at http://www.defra.gov.uk/statistics/foodfarm/farmmanage/fbs/ for further details of these changes. Commentary in this report therefore draws upon the appropriate table from http://www.farmbusinesssurvey.co.uk/regional/ for 2010/11 plus Farm Accounts in England for 2009/10 where applicable http://www.defra.gov.uk/statistics/foodfarm/farmmanage/fbs/publications/farmaccounts/farm-accounts-2011/"

All farms

In the West Midlands the average farm size in 2010 was 112 ha compared with the average for England of 146 ha. The tillage area recorded was 35% lower than the figure for England reflecting the higher area of permanent pasture (+8%) and greater prevalence of livestock enterprises in the region. An average of 124 livestock units per farm was recorded while the average for the whole of England was 97 units a fact reflected in labour units per farm in the region being higher than the average for England at 2.8 units (England 2.59).

Average Farm Business Income (FBI) in the region was £53,856, while that reported for England was £57,266. In comparison to 2009, FBI in the region was £41,495 (Farm Accounts in England), with FBI seeing an increase of 30% in 2010. Total variable costs expressed as a proportion of £100 of total farm output remained relatively constant between 2009-10 and 2010-11 at £37. Increased costs associated with livestock were offset by inputs associated with crop production being lower in 2010-11. Balance sheet data can be found in table 11 which shows higher land values impacted positively on the region's farm balance sheets in 2010, with an 8.9% increase in the value of total assets. Total liabilities also increased over the year, ending at £144K which represented a 4.1% increase with observations of significant investment during the year.

Cereals

The West Midlands cereal sample size fell below the minimum threshold for publication in 2010 therefore the following commentary relates to the sample for England. The average size of a cereal farm was 187.2 ha in 2010 and the split between tenanted and owner occupied was 35.9% and 64.1% respectively. Total tillage area was 154.8 ha, (including 138.25 ha of combinable crops), 15.39 ha of grass and 5.47 ha of potatoes, sugar beet and other crops which included horticulture. Total labour on these farms was 1.59 labour units, a lower figure than the 2.59 for the all farms group for England.

Farm business income in 2010 was £84,836, up from £41,991 in 2009 (Farm Accounts in England) due to largely to higher output and lower cost of fertiliser. Total farm assets for the England cereal group stood at £1.79M up 9% during the year as a result of an 8%

increase in land values. Machinery and equipment valuation also increased during the year highlighting investment. Farm liabilities increased by 4%, culminating in net worth up 10% on the previous 12 months period.

Dairy

The average size of a dairy farm in the West Midlands was 102 ha, supporting 118 dairy cows and heifers in milk. Farm size and stocking was lower than the average for England which stood at 139 ha with 145 dairy cows and heifers in milk. Labour requirement for dairy in the West Midlands was less at 3 labour units per farm compared with the figure for England of 3.6 units. Arable cropping on these farms at 11.5 ha was lower than the England average of 21.9ha.

Total farm output in 2010 was £332k and FBI was £69,586 which represented an increase of 8% on the figure of £64,534 recorded for 2009. Costs as a proportion of £100 farm output showed some variance between 2009 and 2010 with a marked increase in the cost of purchase and homegrown feed and fodder, up from £24.4 to £26.2 respectively. Overall variable costs (as a proportion of £100 farm output) rose by £1.1 to £41.3. Fixed costs fell by £1.6 to £42.9 per £100 of farm output.

In 2010 a 10% rise in total farm assets was observed with the largest contributing factor being a 12% increase in the value of land and buildings. This increase was higher than that seen in the England sample for which an increase of 8% was recorded. Total liabilities also increased over the year due to an increase in bank overdraft and short term loans. With the rise in value of farm assets exceeding that of liabilities, net worth grew by 9% in 2010.

General Cropping

The average farm size in the West Midlands was 128 ha and grass accounted for just 14.4 ha. Arable cropping accounted for 75 ha with a further 21.4 ha down to potatoes, a figure significantly higher than the England sample (14.3 ha), reflecting the prevalence of vegetable [including potato] growers in the region. Total livestock units on these farms were 21, while for the England sample there were 15 units per farm. Labour use per 100 ha of land was considerably higher at 3.5 labour units than for the England sample of 1.5 units per 100 ha of land.

Farm profitability in 2010 was much improved on the previous year with FBI of £121,139, up 102%. Of particular note was the £7.3 fall in variable costs as a proportion of £100 of farm output, with fertiliser and crop protection costs down £1.9 and £1.7 respectively by this measure; an observed fall of £4.2 per £100 of farm output is thought to be mainly due mainly to the change in the composition of the sample between the two years.

The balance sheet for general cropping farms ended the year with a net worth of £999.8k, up 15%. Increased land values of 11% and lower external liabilities were the main reasons for the improvement. The decrease in liabilities was mainly due to reductions of 11% and 15% to bank term loans and other short term loans, which collectively led to a decrease in external liabilities of 8%. The decrease in external liabilities and the double digit growth in net worth for farms in the region was not reflected in the England sample, where net worth increased by only 7%.

LFA Grazing Livestock

The average area of the LFA farms in the West Midlands was 101 ha, a lower figure than the England average of 149 ha. The owner occupied area in the region was 71.3 ha in comparison to the average for England of 48.5 ha. Tillage area was higher in the region at 6.1 ha than for England at 2.3 ha. The area of permanent pasture accounted for 93% of grass which was broadly in line with the average for England. Stocking levels in the region was 97 livestock units per farm, in comparison to 104 units for England.

Farm business Income in 2010 was down from £19,309 in 2009 to £15,849 (Farm Accounts in England). The decrease in FBI could be attributed to an increase of £6.30 per £100 of farm output with increased cost of £3.70 for home grown feed costs reflecting both the high value of home grown grain in 2010 and the long hard winter of 2010/11. Although the farm overheads share of farm output increased by £1.1 per £100 in 2010 there was a notable increase in the labour share, up £3.1, to 8.5 per £100 of farm output, but was offset by the proportion taken up by contracting falling from £5.6 to £3.4.

At the end of 2010 the farm balance sheet on these farm had on average seen a 11.6% increase to total farm assets, up from £787k to £879k with most of the asset value increase attributed to higher land values. Total liabilities rose by 66% over the year indicating an upward trend in investment at a time of low interest rates. Net worth ended the year 8.5% higher than in 2009 at £886k, this increase was also seen in the England sample, though at a lower rate of 5.9%.

Lowland Grazing Livestock

The average size of lowland grazing farms in the West Midlands was 106.7 ha a slightly lower figure than the England average of 111 ha. Grass accounted for 83.7 ha with 81% of that being permanent pasture, a figure very similar to the England average of 80% in 2010. Tillage areas accounted for 18.57 ha a much higher figure than that of the England sample with just 11.77 ha cropped. Stocking was also higher than the average for England with 125 units per farm in comparison to 105 units for England. Stocking in the region was made up of 151 head of beef cows and other cattle, and 376 ewes and other sheep. Labour use was also higher in the region than the England sample and this was attributed to larger farm size and higher cropping and stocking than that of the England sample.

The lowland grazing livestock farm type saw its FBI reduced in 2010 from £24,370 (Farm Accounts in England) in 2009 to £17,927. The fall in profitability can be mainly attributed to rising costs with the variable costs share of output up by £5.9 per £100 of farm output and fixed costs, up by £2.2. As with the LFA farms there was a sharp upward movement for home grown feed costs [+£3.3 per £100 output] and other livestock costs [+£1.1 per £100 output.

Total farm assets increased by 11% with rising land value increases again being the largest contributing factor. Machinery and equipment valuation increased by 10% following higher investment in 2010. Total external liabilities fell from £60,816 to £58,152, a feature not observed in the England sample. The reduction in liabilities was mainly attributable to lower non-bank loans and HP loans. Net worth ended the year up 10%; up 6% for the England sample.

Mixed Farms

Mixed farms in the West Midlands averaged 173 ha, 8% higher than that of the England sample which averaged 160 ha. Tillage areas accounted for 75.89 ha and grass accounted for 88.0 ha of which 75% was permanent grass and 25% was temporary leys. The area of permanent grass in the region was higher than that of the England sample. Cropping was mainly winter and spring combinable crops while potatoes averaged 3.91 ha. Stocking in the region showed higher cattle numbers and slightly higher sheep number than the England sample (25% and 33% respectively), fewer pigs (-50%) and significantly higher poultry numbers (175% higher). Labour use in the region was higher than that of the England sample at 2.78 labour units per holding in comparison to 2.61 units for England.

Profitability on these farms showed a considerable increase in 2010 with FBI at £46,417, an increase of 66% on the 2009 figure of £28,022. The growth in output was the main reason for the positive turnaround with much improved returns from combinable and cash crops. Other factors included tight control of variable costs and trimming of fixed costs with the share of the former as a proportion of £100 of farm output up by only £1.4 and the share of the latter down £4.2. Among the variable costs there was a significant increase of £4.6 per £100 of output for purchased concentrate feed and fodder that was

largely offset by reductions to the cost of fertiliser and crop protection. Whilst for fixed costs the share per £100 of output for contracting and land and buildings fell by £1.4 and £1.5 respectively.

The balance sheet for mixed farms in the region saw a 9% increase to total fixed assets, which again was mainly attributed to an 11% increase in land values. Current assets also increased across the year with a 4% increase in crops and trading livestock values and a 20% increase in the value of feedstuffs and goods in store. Liabilities rose during 2010 by 13% due to increased levels of bank term loans and HP agreements, which indicated higher investment than normal during the year.

Horticulture

The average size of FBS horticulture businesses in the West Midlands sample was 32 ha, much less than the average of 45.1 ha for the England sample. Tenure status of these businesses was 29% tenanted and 71% owner occupied. In line with the smaller land area of these businesses, average areas of horticulture crops was lower than for the England sample, with the exception of top fruit, where the average area on each farm was 10.7 ha against the England average of 5.1 ha. Annual labour use was also higher in the region at 9.6 units per holding in comparison to 3.8 for England.

FBI increased markedly in 2010 to £106,252, up £26,576 (+33%) from 2009 (Farm Accounts in England).

Balance sheets showed rising farm assets, up by 6% as a result of a £36K increase in the value of land and buildings (+7%). Improved business productivity led to healthy improvements to current assets, which grew by 11%. Liabilities decreased by 7% as HP finance and bank overdraft levels fell compared with 2009, leading to a 10% increase in net worth.

Pigs (England)

This commentary is based on the national sample of 75 pig farms across England. The change of FBS farm classification to the Standard Output basis, resulted in a change in the farm type label for a large number of farms to Specialist Pig, and this in turn, resulted in a 23 per cent increase in sample size, in comparison with last year. Our report includes all types of pig production system, both independent and contract producing units. The average pig farm was stocked with 2,408 pigs, this is 5.5 per cent higher than those in last year's report, but the increase is likely to be from larger farms within the grouping.

The FBI of Specialist Pig farms averaged £44,439 in 2010/2011. An increase in the size of the breeding herd in Europe was the main driver of reduced prices; the Deadweight Average Pigs Price (DAPP) of 141.62 pence per kilogram at the end of April 2011 was two pence per kilogram below the price at the same time in the previous year[1]. The lower price may have contributed to improved UK demand for pigmeat, this increased by 6 per cent in February 2011, compared with February 2010, and the upward price trend was expected to continue[2]. Seasonal events can also determine market opportunities; at Cranswick plc, which had acquired Bowes of Norfolk in 2009, sales of fresh pork were 27 per cent higher in the six months to September 2010 than in the previous year, boosted by a good barbeque season and the World Cup[3].

Overall, producers faced higher production costs as between June and December 2010, British weaner prices dropped by 24 per cent[4]. This development favoured those with finishing units, but correspondingly reduced revenue to breeders. Higher grain prices had an impact on feed, which accounted for 55 to 60 per cent of production costs[5].

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[1] Farmers Weekly 28 April 2011
[2] Farmers Weekly 6 April 2011
[3] FoodEast, www.foodeast.com November 2010
[4] Farmers Weekly 1 December 2010
[5] Farmers Weekly 24 August 2010

Outdoor pig production was especially challenging in the winter of 2010 and early spring of 2011. Extreme cold weather created challenging conditions for stock survival and mortality increased. Staff also faced difficult working conditions, faced with maintaining supplies of drinking water to stock, when freezing of water in pipes was difficult to avoid. Some units were compelled to make early unscheduled moves, following rain and the creation of wet conditions.

The capital position of Specialist Pig Farms was reasonably stable but with only a three per cent fall in stock values. However, there was an eight per cent rise in the value of land and buildings. Overall, the closing net worth of £592,337 per farm compared favourably to the opening figure of £555,440.

Poultry (England)

This commentary is based on the national sample data. The 2010/11 sample of 97 egg and broiler, turkey and duck producers was 30 higher, than the previous year. The main reason for the increase was the reclassification of FBS farms by Standard Output. In the expanded sample, the average farm size was larger, and the average bird numbers per farm were 20 per cent higher for hens and pullets, and 40.6 per cent higher for broilers and other poultry. The average FBI for this group was £68,219 per farm; significantly lower than the 5 year average.

Disease threats to poultry flocks were mainly restricted to continental Europe. The first European H5N1 detections in 2010 in March/April, were found in backyard poultry in Romania[6]. In July 2010 infectious coryza (respiratory disease) was confirmed in two separate hobby flocks in Southern England, adding to health and hygiene concerns. The threat from Avian flu remains constant, but cases seem to have steadied. In Europe, Germany in particular, suffered from dioxin contamination originating from feed products.

Poultry output averaged £679,611 per farm.

Feed costs comprised 60% of costs in 2010, mainly due to the impact of higher wheat prices. The long cold winter again impacted on heating and feed in December 2010 and January 2011. Producers experienced increases, in the costs of labour, partly due to maintaining buildings and water systems, over a hard winter, contract and fuel. Increasing feed prices eventually forced an increase in the price of chicks and pullets to egg producers[7].

Some 27.4 million cases of eggs were packed in 2010, compared to 24.6 million in 2009, an 11% increase. The average price per dozen fell by 3.5% to 70p, compounding the pressure from rising input cost[8].

The impending January 2012 EU conventional cage ban, has been a driver of structural change in UK egg production, bringing investment in free range production facilities, and forcing a decision on producers committed to conventional cage production. During 2010/2011, there were indications from other EU member states, that some continental producers might seek a postponement to the introduction of the European legislation. Jim Paice, the UK Agriculture Minister, made it clear that it would not be acceptable for non-compliant continental producers to export their production[9]. The scale of this problem was quantified by Euro MP and Norfolk farmer Stuart Agnew, who calculated that 83 million eggs a day could be produced from intensive cage or battery systems from January 2012[10]. Proposals to delay the cage ban were eventually overturned in Brussels in March 2011[11].

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[6] AHVLA GB Emerging Threats Report, Avian Diseases, Vol15, No1, Jan – Mar 2011
[7] Farmers Weekly Interactive, www.fwi.co.uk 23 November 2010
[8] The poultry site, www.thepoultrysite.com, UK egg statistics, 1st, 2nd, 3rd and 4th quarter 2010
[9] Farmers Weekly Interactive, www.fwi.co.uk 8 November 2010
[10] Eastern Daily Press, www.edp24.co.uk 2 October 2010
[11] FoodEast, www.foodeast.com March 2011

Furthermore, concerns over imports of cage eggs through processed products still remain[12]. With regard to the cage ban, postponement looks unlikely as the EU reiterates its commitment to this legislation, and to act against non-compliance. Concerns are rising over an illegal trade in caged bird eggs after the ban considering it is estimated to have cost the UK £400 million to upgrade to enriched colony cages. There are also concerns over the possibility that the UK will be put at a disadvantage for leading the way in animal welfare issues[13].

However, during 2010, oversupply was a significant problem for the industry as cage production continued, as the free range units, established to replace them, were brought into production. Production outstripped market demand, leading to lower prices as the layer population hit 34 million birds[14]. This was further compounded by organic producers and cage bird producers switching to free range, as the lack of demand for premium products in an economic recession coincided with the impending cage ban.

Challenges remain for egg producers as feed, pullet and fuel prices continue to increase, whilst packers are able to continue to put pressure on purchase price in an oversupplied market. Whilst there is pressure for a price increase especially in the egg market, the current economic climate means it is difficult to pass on increased costs to the consumer. One answer may be to include feed price conditions into production contracts[15]. Egg producers, also facing higher feed costs, similarly raised egg prices[16].

Poor weather and the recession were the likely reasons for a reduction in demand for Christmas turkeys in 2010 according to the Anglian Turkey Association[17].

The year saw considerable investment in poultry buildings[18]. These included enriched cage units and free range laying units, but most were for table chicken production. The requirement to insulate buildings and improve infrastructure to meet IPPC regulations, were considered to be important drivers of change. This development was reflected by FBS findings as the value of poultry farm land and buildings increased by 12 per cent.

[12] Farmers Weekly Interactive, www.fwi.co.uk, 30th November 2011
[13] The poultry site, www.thepoultrysite.com, 17th November 2011
[14] GB Emerging Threats Report, avian diseases, Vol 14, No 3, Jul-Sept 2010
[15] Farmers Weekly Interactive, www.fwi.co.uk, 23rd November 2011
[16] Farmers Weekly Interactive, www.fwi.co.uk 3 November 2010
[17] Farmers Weekly Interactive, www.fwi.co.uk 5 January 2011
[18] Farmers Weekly Interactive, www.fwi.co.uk 13 January 2011

Appendix 6: Extraction of institutional profile components and variance explained

Total Variance Explained[b]

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.854	18.351	18.351	3.854	18.351	18.351	3.159
2	2.417	11.509	29.860	2.417	11.509	29.860	2.307
3	2.152	10.249	40.109	2.152	10.249	40.109	2.295
4	1.542	7.343	47.452	1.542	7.343	47.452	2.174
5	1.497	7.126	54.578	1.497	7.126	54.578	2.564
6	1.087	5.178	59.756				
7	.985	4.691	64.447				
8	.824	3.925	68.372				
9	.808	3.849	72.220				
10	.754	3.589	75.809				
11	.744	3.543	79.353				
12	.655	3.119	82.472				
13	.633	3.014	85.486				
14	.549	2.616	88.102				
15	.487	2.317	90.419				
16	.462	2.201	92.620				
17	.390	1.858	94.478				
18	.336	1.601	96.079				
19	.328	1.560	97.639				
20	.265	1.262	98.901				
21	.231	1.099	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

b. Have you adopted RE = No

Appendix 7: PCA analysis for country institutional profile for RE

Pattern Matrix

	Component				
	Regulatory support	Normative support of family, friends and business networks	Regulatory complexity	Cognitive institutions	Normative - Social acceptability of entrepreneurship
Government sponsors organisations that help farmers invest in RE	**.771**	.034	-.011	-.051	.055
Government organisations assist farmers start RE	**.756**	.098	-.028	-.020	-.026
Local councils provide support to farmers to set up RE on farms	**.690**	-.075	.012	.001	.143
Government grants are available for farmers starting RE enterprises	**.665**	.059	-.034	-.026	.003
Current policies encourage farmers to adopt RE	**.556**	.039	.005	.243	-.007
Banks have funds available for farmers starting RE enterprises	**.520**	-.092	.026	.132	-.080
My family has social relationships that can help my business	-.008	**.885**	-.034	-.005	.072
I have friends and family that can assist my business development	.000	**.882**	-.056	.030	.048
I have business networks that I can count on for help in case of difficulties	.069	**.774**	.180	.100	-.056

Farmers have to comply with too many procedural requirements	-.087	.003	**.834**	-.011	-.021
Local council procedures discourage farmers from investing in RE	.009	.071	**.821**	-.076	-.010
Procedures for grid connection discourage farmers from investing in RE	.034	-.017	**.780**	-.057	-.061
Farmers know where to find relevant information about RE	.086	.061	-.056	**.753**	-.070
Farmers are familiar with the different financial support packages available to them	.070	.037	.005	**.745**	.019
There are many training programmes for farmers on RE topics	.039	-4.285E-5	-.156	**.696**	-.016
People know a great deal about RE	.036	.056	.025	**.426**	.015
People in the UK tend to admire those who start their own businesses	.272	.051	-.054	-.237	**.759**
Farmers with successful businesses are admired	.175	.042	-.092	-.106	**.706**
Because of climate change investing in RE is a moral obligation	-.191	.078	-.020	.060	**.511**
People that I look up to for advice think it is good to invest in RE	**-.103**	**-.026**	**.002**	**.290**	**.504**
People in UK care a great deal about climate change	**.094**	**-.243**	**.188**	**.167**	**.451**

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 8 iterations.
N/B: Items in bold were removed from the analysis because of serious cross loadings

(Wang and Ahmed, 2009).

Appendix 8: Extraction of cognitive variables and variance explained

Total Variance Explained[b]

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	3.744	37.445	37.445	3.744	37.445	37.445	3.582
2	1.582	15.819	53.264	1.582	15.819	53.264	2.155
3	.880	8.799	62.063				
4	.814	8.140	70.203				
5	.709	7.087	77.290				
6	.591	5.909	83.199				
7	.521	5.205	88.404				
8	.499	4.994	93.397				
9	.384	3.841	97.238				
10	.276	2.762	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

b. Have you adopted RE = No

Appendix 9: PCA for Attitudes towards entrepreneurship in the RE sector

Items	Component	
	Perceived self-efficacy of RE enterprises	Perceived desirability of RE enterprises
Estimate financial viability of the RE enterprise	**.830**	.063
Find right technology that is needed for the farm	**.782**	.075
Raise enough funds to start a RE enterprise	**.747**	.044
Organise and maintain financial records of your farm business	**.697**	-.059
Lead the planning permission process at local council level	**.695**	-.120
Identify new opportunities and act on them	**.686**	.088
RE can help improve the economic success of my business	-.042	**.843**
If I start a RE enterprise it will help me achieve other important non-economic goals in my life	-.112	**.689**
RE production is not a viable option compared to my existing farm business activities (R)	-.099	**-.656**
There are new market opportunities in RE if i want to exploit them	.114	**.588**

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Appendix 10: levels of measurement of variables

No	Level of measurement	Definition	Examples
1	Nominal	A classification of objects into discrete categories that cannot be ranked. The only thing that can be done with these variables is to report their frequencies of occurrence.	Farm type
2	Ordinal	Objects can be ordered in terms of a criterion from highest to lowest.	Levels of income
3	Interval (a)	Variables which some researchers would call ordinal. They have a large number of categories as in multiple questionnaire items. This variable has an arbitrary zero so that a value of zero does not indicate that there is none of the quantities being measured. The variables are assumed to have similar properties as ration variables.	Perceived feasibility, intentions
4	Interval (b) or ratio	Categories associated with the variable can be ranked ordered but the distance between the variables is equal. A scale zero means there is no quantity being measured. SPSS does not distinguish between interval and ratio variables.	Income in pounds, age in years
5	Dichotomous	A variable that comprises only two categories	Gender

Appendix 11: Summary statistics and pairwise correlations

Summary statistics, means and standard deviations (N=338)

Variables	Mean	Std. Deviation
Intentions to invest in RE enterprises	3.17	1.05
Dummies for type of farm diversification		
Dummies accommodation	0.12	0.33
Dummies agricultural contracting	0.14	0.35
Dummies non agricultural contracting	0.07	0.26
Dummies for type of tenure		
Dum_whoten	0.12	0.32
Dum_mainten	0.11	0.32
Dummies for agricultural turnover 2009		
Dum_50	0.31	0.46
Dum_50_99	0.15	0.35
Dummies for type of farm business ownership		
Dum_solpro	0.25	0.43
Dum_part	0.67	0.47
Dum_5years	0.01	0.12
Dummies for years of experience in agriculture		
Dum_14years	0.04	0.20
Dum_24years	0.08	0.27
Dummies for educational attainment		
Dum_belowsec	0.05	0.22
Dum_sec	0.66	0.47
Dum_uni	0.23	0.42
Regulatory Support for RE	3.16	0.62
Regulatory complexity	2.39	0.82
cognitive institutional dimension	2.71	0.69
Society's admiration for entrepreneurship	3.40	1.02
Normative support of friends, family and business networks	3.14	1.02

Pairwise correlations between dependent and independent variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
Intentions to invest in RE enterprises	1												
Dummy leasing/accommodation	0.12c	1											
Dummy agricultural contracting	0.15b	-0.03	1										
Dummy non agric. Contracting	-0.03c	0.06	0.22a	1									
Tenure	0.04	0.07	-0.09c	-0.05	1								
Agricultural turnover 2009	0.30a	-0.11b	0.04	-0.12b	-0.34a	1							
Structure of farm business	0.14b	0.05	-0.01	0.08b	-0.02	0.26a	1						
Education attainment	0.13b	0.01	-0.04	-0.06	0.06	0.06	0.04	1					
Years of experience in agriculture	-0.09c	-0.06	-0.05	-0.08b	-0.03	0.08a	-0.06	-0.08b	1				
Regulatory support for RE	0.06	0.00	0.01	0.04	-0.01	0.02	0.00	0.01	0.05	1			
Regulatory complexity	0.02	0.09b	-0.08b	0.04	-0.08b	0.13b	0.03	-0.10b	0.10b	-0.05	1		
Cognitive institutional dimension	0.17a	-0.03	-0.06	-0.14b	0.04	0.13b	0.05	-0.05	0.13b	0.28b	-0.01	1	
Society's admiration for entrepreneurship	-0.09c	0.04	-0.02	0.06	0.07	-0.09b	0.05	-0.11b	0.02	0.28b	-0.06	0.21b	1
Normative support of friends, family and business networks	0.26a	0.06	0.17a	0.07	-0.05	0.24a	0.27a	-0.05	-0.04	0.10b	-0.03	0.25b	0.08b

Level of significance: a= ≤ 0.001; b= ≤ 0.01; c= ≤ 0.05; d= ≤ 0.10

Appendix 11: Path analysis 1: The influence of institutional factors on perceived feasibility

Independent variable	B	SEE	β	t	Sig.
(Constant)	2.93	0.316		9.29	0.000***
Dummies accommodation	0.22	0.106	0.10	2.13	0.034*
Dummies agricultural contracting	0.07	0.108	0.03	0.61	0.540
Dummies non-agricultural contracting	0.20	0.145	0.07	1.35	0.178
Dum_whoten	-0.19	0.129	-0.08	-1.48	0.139
Dum_mainten	-0.28	0.134	-0.12	-2.10	0.036*
Dum_mainown	-0.11	0.093	-0.06	-1.13	0.258
Dum_50	-0.33	0.134	-0.20	-2.46	0.014*
Dum_50_99	-0.25	0.139	-0.12	-1.76	0.079
Dum_100_499	-0.12	0.115	-0.08	-1.06	0.291
Dum_belowsec	-0.85	0.243	-0.23	-3.52	0.000***
Dum_sec	-0.70	0.170	-0.44	-4.11	0.000***
Dum_uni	-0.48	0.178	-0.28	-2.67	0.008**
Dum_5years	0.35	0.309	0.06	1.15	0.252
Dum_14years	0.28	0.211	0.07	1.33	0.186
Dum_24years	0.06	0.136	0.02	0.42	0.675
Dum_solpro	-0.09	0.154	-0.05	-0.55	0.579
Dum_part	-0.01	0.135	-0.01	-0.09	0.931
Regulatory support for RE	0.14	0.063	0.16	2.36	0.001***
Regulatory complexity	0.09	0.045	0.10	2.08	0.338
Cognitive institutional profile	0.23	0.058	0.22	4.06	0.000***
Society's admiration for entrepreneurship	-0.07	0.038	-0.09	-1.80	0.073†
Normative support of friends, family and associational networks	0.20	0.039	0.27	5.04	0.000***

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10F=6.05, p= 0.000, Adjusted R^2= 0.25

Appendix 12: Path analysis 2: The influence of the country's institutional profile on perceived desirability of the venture

Independent variable	B	SEE	β	t	Sig.
(Constant)	2.73	0.350		7.80	0.000***
Dummies accommodation	0.00	0.120	0.00	0.00	1.000
Dummies agricultural contracting	0.00	0.117	0.00	0.00	0.999
Dummies non-agricultural contracting	-0.04	0.164	-0.02	-0.26	0.794
Dum_whoten	0.03	0.134	0.01	0.19	0.848
Dum_mainten	-0.14	0.141	-0.07	-1.00	0.317
Dum_mainown	-0.12	0.099	-0.08	-1.16	0.246
Dum_50	-0.49	0.142	-0.34	-3.42	0.001***
Dum_50_99	-0.27	0.148	-0.14	-1.83	0.069†
Dum_100_499	-0.29	0.120	-0.21	-2.44	0.015*
Dum_belowsec	-0.30	0.248	-0.10	-1.22	0.222
Dum_sec	-0.28	0.181	-0.20	-1.57	0.118
Dum_uni	-0.33	0.192	-0.20	-1.69	0.092†
Dum_5years	0.30	0.347	0.05	0.88	0.381
Dum_14years	0.01	0.210	0.00	0.05	0.963
Dum_24years	0.07	0.150	0.03	0.49	0.627
Dum_solpro	0.00	0.173	0.00	0.03	0.979
Dum_part	0.03	0.152	0.02	0.18	0.857
Regulatory support for RE	0.12	0.070	0.10	1.77	0.038*
Regulatory complexity	0.02	0.049	0.03	0.46	0.649
Cognitive institutional profile	0.18	0.063	0.19	2.82	0.005**
Society's admiration for entrepreneurship	-0.01	0.042	-0.01	-0.14	0.892
Normative support of friends, family and associational networks	0.04	0.043	0.06	1.00	0.320

Level of significance: ***p≤ 0.001; ** p≤ 0.01; *p≤ 0.05; †p≤ 0.10

F= 1.97***, Adjusted R^2= 0.07

Appendix 13: Personal learning and reflections

During the last months of my MSc studies at Humboldt University Berlin, I started to ask myself serious questions about what I wanted to do after that. With a degree in Agricultural Engineering and a MSc. degree in Rural Development, there was only one thing in my mind - go back to Cameroon and look for employment in the field of development. During my end of course research work (which overlapped with a research trip to Indonesia), the idea of developing a career in academia gradually started to creep in. This research trip to Indonesia made me to come face to face once again with action research and how research could help bring answers to everyday problems in this case, small scale poor farmers in Purballinga regency in Central Java - Indonesia. For the first time I had a serious discussion with my wife about the implications of this to the family (I had already been away from home for two years) as it was likely that if this were to be pursued, this will mean a couple more years away from them. Should I do a PhD? I had the unconditional support of my wife (my son was just above 1 year). Like Lingreen in Lingreen *et al* (2001, p.507), a PhD would provide me the official blueprint that says 'this person is capable of carrying out research using well established scientific methodologies' and on top of that most established research institutes and universities require one to have this blueprint if one wants to pursue a career within academia. The original contribution to knowledge will only come later as I did not have any prior experience or discussions with any doctoral candidate about what this entailed and what this required. All I thought about was that I was "intelligent" enough to do whatever I wanted if I decided to put in the effort. I then started the process of looking out for opportunities for study particularly studentships. This involved responding to offers and writing a dozen research proposals with no success. With just two months left to the end of my studies and no success with applications, I decided to put together a research proposal of interest and to use it to look for funding. I

immediately got an offer from Humboldt University and started the process of seeking funding for the research project.

It was a week after I was offered a place at Humboldt that I found the offer of a PhD studentship at the University of Wolverhampton Business School to carry out research on the topic "Bioenergy and the farmer: a viable business proposition?". I found this very interesting because the topic was contemporary and it fitted perfectly with my background in Agronomy and international development. There was a two stage application process and I was offered the position after the second interview stage. The difference here was that the research topic, research problem and research objectives were more or less defined by my now Director of Studies (DoS) Dr Graham Tate. From the research proposal, it was clear that the focus was to analyse financial viability of bioenergy enterprises and feasibility. I started on the 1st of October 2009.

When I arrived in the UK to start my studies, my supervisory team was already decided. I was introduced to the University and the process of carrying out a PhD. I was given the code of practice and documentation about best practice. Lecturers and administrative staff were very supportive and this helped me to settle down and to get on with my work. My prior European cultural experience was very helpful.

I must state that at the beginning of my studies, I did not really question the relevance of the research topic as laid out in the research brief (the studentship offer). The topic appeared well defined and because it was about bioenergy, it made sense to focus on the financial questions which at the time were stated very strongly in the research brief as the most important factors affecting potential take up of bioenergy by farmers in the UK. My first meetings with my DoS and supervisory team members emphasised this view (see box 1).

Aim

The proposed research will investigate the financial viability of a wide range of potential farm enterprises in the bio-energy sector and to construct web-based computer software that farmers can use to forecast enterprise viability.

Benefits

A number of input and output costs including capital grants, interest rates, taxes and the value of outputs (including carbon offsetting, emissions trading, Renewable Obligation Certificates or ROCs) fluctuate. Together with the individual farm circumstances such as distance to market, grid connection charges and labour costs and availability make farm business budgeting very difficult and imprecise. The project will examine a range of the most common bio-energy enterprises, examine the experiences and costings of these enterprises and produce accessible web-based materials that can easily be updated for the fluctuations mentioned above.

Objectives

1. To comprehensively examine the up to date business position with respect to Government involvement and the capital costs and returns of bio-energy projects such as the bio-energy capital grant, ROCs, emissions trade and carbon offsetting.
2. To examine a range of the commonest farmer operated bio-energy enterprises, in co-operation with the owners and to explore the bases of the costs and returns and where and how these can vary due to timing or the geographical position of the farm.
3. To design and host a web-based financial management package that is accessible to farmers, which can be readily updated for an individual farm business situation to provide meaningful financial data that will assess the financial viability of a range of potential bio-energy

Source: Tate (2009) Studentship Research Brief

I was expected to develop a work plan with measurable outputs against which progress will be monitored. The first year's work plan included supervisory meetings, carrying out a

literature review with the view to identifying the knowledge gap. Supervisory meetings were scheduled as well as other personal development activities. The first year indicator of success was admission to PhD given that I was expected to go through the Mphil/PhD study route.

I started to explore the literature and one big time waster which any PhD student should avoid is to try to download as many interesting articles as possible from the internet with the expectation to read them later on. I was overwhelmed by information and finding what was relevant for the study was an uphill task. Given my continuous focus on the financial aspects of RE, my literature search was narrow and the more I tried to understand the subject the more the articles I read seemed to reemphasise the importance of economic drivers for RE development in the UK farm sector. I began to question myself as to what new knowledge I could contribute. I immediately realised the need to get out of the library and to understand the context of renewable energy from the viewpoint of the farmer. Renewable energy was new to me anyway and I needed to see for myself what these enterprises looked like in practice. I went out to a number of RE road shows, exhibitions and most importantly to farm business premises. This gave me the chance to talk to non-academics who were knowledgeable about RE and to get a glimpse of the key concerns of the actors I was supposed to study. I realised that there was a vibrant community of organisations involved in the sector as well as a farming press keen on publishing and providing information to farmers about these novel enterprises. This experience made me to understand that clearly the economics of RE was important but not necessarily priority for many stakeholders including farmers. By going out to these events and speaking with farmers, made me to realise that this is how I should have started my research. I realised that I needed to approach this research from the viewpoint of the final user – the farmer. Additionally, and this will affect my model later, as the financial drivers were important but even more relevant were non-financial factors.

My literature search changed drastically after this experience. I began to read the farm press, grey literature, entrepreneurship as well as small business literature. Around this same period, calls for papers for the 8th Rural Enterprise Conference were published and I was encouraged by my DoS to attend. I started to write my first conference paper in 2010. This gave me the opportunity to critically evaluate my reading and to tease out future directions for the study. I received very useful feedback from my supervisory team on my writing style, and gradually developed the art of writing for publications. Additional training on "writing for publication" from the University was very useful in this direction. I would later on present at five other conferences (national and international) and PhD colloquiums, win two poster competitions, two best research student paper awards and publish four peer reviewed journal articles. All of these influenced my research methods and proved very useful during the final write up stages of thesis. I was very keen to take advantage of all learning opportunities that were available in the University in a bid not only to facilitate completion of the thesis in time, but to ensure employability after completion of my studies. I took part in a series of personal development trainings including writing CVs, presentation and communication skills, project management, teaching toolbox for non-academic staff and many others. I started teaching in the Department of Marketing and Enterprise in 2010 as visiting lecturer on a number of undergraduate and postgraduate modules. My rural development background led me to work with the University's Centre for International Development and Training providing technical and advisory support to projects in Africa.

From every indication, my learning did not follow any linear process. It was more a process of being embedded in a system of learning, interacting with the system and exploiting opportunities that could be derived. Clearly what I learnt can be neatly summarised in line with the University's code of practice guidelines.

By completing my thesis in good time, writing and presenting conference papers/posters as well as publishing in peer reviewed journals enabled me to demonstrate my ability to recognise and validate problems, original, independent and critical thinking, and the ability to develop theoretical concepts as well as show knowledge of recent advances within my field and related areas. Very important I showed an understanding of relevant research methodologies and techniques and their appropriate application, the ability to critically analyse and evaluate one's findings and those of others as well as an ability to summarise, document, report and reflect on progress. One advantage of presenting my research at conferences to external audiences, was the exposure to a wide range of research approaches – in terms of their merits and demerits and the conditions for their application. When I started my postgraduate studies, one of my objectives was always to develop a proficiency in modelling and statistics. By the time I completed my MSc. degree I still felt that I was a leaky boat in that direction. I was therefore determined that my doctoral studies were the best opportunity to gain this skill. It must be said that this personal development objective was a key driver in my choice of research method during my doctoral studies. Of course the research problem and research objectives played a role as well. My approach to reality and to the creation of knowledge was from a purely pragmatic stance as shown above. I attended a number of quantitative and qualitative training workshops organised as part of the University's doctoral training programme but these were not enough for what I wanted to do. I engaged in self-study and presentation of my approaches at conferences was a useful way to get feedback on my proposed methods and tools. I was able to receive valuable feedback from researchers in quantitative methods.

Submitting articles for publication and at conferences helped me because I received very valuable comments and feedback. I strongly believe that this is the best way to prepare for the final stages of the PhD especially the write up and viva. Articles published in peer reviewed journals strengthen the relevance of the study and further illustrate contribution

to knowledge. An additional benefit for publishing during my studies is that it helped improve my writing. Given that English is not my first language, I believe that continuous practice helped enormously enabling me to write clearly and in a style appropriate to purpose, e.g. progress reports, published documents, thesis. One thing which helped me a lot is the fact that I did not wait until the third year to start writing up the thesis. By putting together all the chapters of the thesis in good time took off a lot of pressure from myself and gave my supervisors adequate time to feedback on the individual chapters and the subsequent 3 drafts of the thesis before final submission.

My presentation and communication skills have also improved significantly as seen in my ability to construct coherent arguments and articulate ideas clearly to a range of audiences, formally and informally through a variety of techniques, constructively defend research outcomes at seminars and viva examination. One key communication skill proposed in the University's code of practice is the ability to effectively support the learning of others when involved in teaching, mentoring or demonstrating activities. I had the opportunity to teach a wide range of subjects ranging from statistics, research methods and international marketing. This experience has been very enriching as it enabled me to integrate into the university system. It gave me the chance to interact with students, learn from them and in my little way help them in their learning. The statistics and research methods courses were very useful during my research design phase and data analysis. I engaged in a process of self-study of quantitative data analysis technics which I applied successfully in my data analysis. I was able to provide advice to students during development of their research proposals based on my own experience which the students found very useful.

Networking and teamwork enabled me to develop and maintain co-operative networks and working relationships with supervisors, colleagues and peers, within the institution and the wider research community. It helped me to understand my behaviour and impact on others

when working in and contributing to the success of formal and informal teams. The actual process of networking and teamwork started with my supervisory team especially my DoS who would introduce me to people within and out of the University. Important examples include creating links with the National Farmers' Union, Harper Adams University College and Reading University. The NFU provided the data base for my study, I would later on present my research findings at Harper Adams while contacts at Reading University were useful during quantitative data analysis. Contacts from other supervisory team members led me to field visits, presentation of conference papers in the United States and subsequently publications in Biomass and Bioenergy journals. Through references from my supervisory team, I subsequently became member of the Association of Applied Biologists and the Institute for Small Business and Entrepreneurship. Through these associations I created useful professional links and it was useful to be part of a family of researchers.

By carrying out this research, I significantly improved my research and project management skills as demonstrated by my ability to apply effective project management through the setting of research goals, intermediate milestones and prioritisation of activities. This was enhanced by regular planning and evaluation of activities during bi monthly supervisory meetings and annual progress reviews. This rigorous system ensured that my studies were completed in good time and under budget. I studied how to use SPSS in statistical data analysis, Nvivo for qualitative data analysis and used a range of bibliography software (Endote and Endnote web and Refworks). Years of using online and library resources and the above mentioned software developed my skills to design and execute systems for the acquisition and collation of information, identify and access appropriate bibliographical resources, archives, and other sources of relevant information as use information technology appropriately for database management, recording and presenting information. The use of the bibliography software was very important during

the final stages of write up as putting together bibliography can be quite a challenge. This made sure that all my references were well documented and accessible when I had to generate the bibliography. Using the software also ensured consistency in the presentation of the references and time was saved. Finally, I am very confident with quantitative data analysis which is a personal goal I failed to achieve during my postgraduate studies. All the above factors contributed to develop personal effectiveness, increase awareness of the research environment and enhanced career development (box 2).

Personal Effectiveness – was able to:

1. demonstrate a willingness and ability to learn and acquire knowledge
2. be creative, innovative and original in one's approach to research
3. demonstrate flexibility and open-mindedness
4. demonstrate self-awareness and the ability to identify own training needs
5. demonstrate self-discipline, motivation, and thoroughness
6. recognise boundaries and draw upon/use sources of support as appropriate
7. show initiative, work independently and be self-reliant

Research Environment – was able to:

1. show a broad understanding of the context, at the national and international level, in which research takes place
2. demonstrate awareness of issues relating to the rights of other researchers, of research subjects, and of others who may be affected by the research, e.g. confidentiality, ethical issues, attribution, copyright, malpractice, ownership of data and the requirements of the Data Protection Act
3. demonstrate appreciation of standards of good research practice in their institution and/or discipline
4. justify the principles and experimental techniques used in one's own research
5. understand the process of academic or commercial exploitation of research results

Career Management – was able to:

1. appreciate the need for and show commitment to continued professional development
2. take ownership for and manage one's career progression, set realistic and achievable career goals, and identify and develop ways to improve employability
3. demonstrate an insight into the transferable nature of research skills to other work environments and the range of career opportunities within and outside academia
4. present one's skills, personal attributes and experiences through effective CVs and interviews

Source: University of Wolverhampton Code of Practice for Postgraduate Research Programmes, 2011

I also faced many challenges during my studies. Though I had experience of European Education, settling into the UK during the first year was quite a challenge. This was made difficult at the beginning because I was still alone without my family. When my family finally had to join me in the UK they were initially refused entry to the country which made the situation even worse. This was very distracting and meant weeks and months which went by without full concentration on my studies. They were later on granted entry after appeal.

Another key issue related to receiving and dealing with feedback. I realised that culturally supervisors and colleagues were really never direct in providing feedback. I always felt like the idea was not to hurt my feelings but I was proactive and indicated to my supervisory team that I would prefer direct feedback on my work. I learnt better when I was made to understand that an approach I was taking was wrong and needed attention. While this aspect improved my learning, accepting revisions and re-writing significant sections of chapters proved very difficult. When I started submitting papers to conferences and for publication, that I fully understood the strength of direct feedback and the need to have an open mind. I must mention that one of my biggest challenges dealing with feedback came at the end of my second year. I had just completed preliminary analysis of my data and made a presentation at the Business School Research conference. My writing style, methodology and results were fully challenged during the conference and I left the conference very demotivated as I thought that the feedback was hard. I started to question myself and the conclusion I reached was simple: clearly there was something wrong during my presentation – it was either I did not present my work in a way that was understandable or that there was something to be concerned about with the content of my work. This realisation was useful as I latterly had other discussions with colleagues in the department, who clarified their points and made me to understand the weakness in my work. It was

only by responding to this feedback and internalising the comments received that I was able to modify my work which led to the successful and timely completion of my research.

Another key challenge was to do with information management – keeping my learning diary, security of my documents (files) and loss of written material. Early on in my studies I was introduced to the University's online learning platform (Pebblepad). I never got to use the platform as I found it quite confusing. I resorted to keeping personal diaries. Until the end of the studies I still struggled with keeping a record of my daily research activities. However, I have since found that using Microsoft Outlook has helped me to keep a diary and keep track of my activities. I lost my memory sticks on two occasions but thankfully because I had developed a consistent approach to backing up my files setbacks due to information loss were minimised.

The PhD research process can sometimes be very lonesome and demotivating. I found that staying in touch with other research students in the Business School and the University was very helpful. I also took part in a couple of PhD Colloquiums which gave me the opportunity to interact with other PhD students who were in the same situation as myself and to share experiences. This made me to realise that I was not alone in the process and that some of the challenges I was facing were not necessarily unique. It was relevant to know what and how other candidates dealt with such situations. I believe that by getting involved in many other activities apart from just study was helpful to deal with periods of demotivation. As mentioned earlier I got involved in teaching as well as working with the CIDT. This helped me to use my time more effectively, improved my CV and helped me to get employment with the Business School a few days before my viva.

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